Radiation Dosimeter Exchange: Direct Radiation Pathway

A. Purpose

The purpose of this procedure is to outline the surveillance activities for determining the direct radiation levels in the environment surrounding the Wolf Creek nuclear-powered generating station (WCGS).

B. Applicability

The activities in this procedure are done by Kansas Department of Health and Environment staff. There are no specific personnel qualifications associated with this section.

C. General Description

Direct radiation monitoring is accomplished by the Radiation Control Program's thermoluminescent dosimetry (TLD) system, which consists of a Victoreen 2800M reader using Victoreen Model 2600-49 axial bulb manganese-doped calcium fluoride (CaF_2:Mn) radiation dosimeters. The dosimeters are individually calibrated to ^{137}Cs (cesium) and each reading is corrected for fading, self irradiation, and any dose received while in transit.

Thirty-one locations around the WCGS are monitored by KDHE, including three control locations greater than ten miles from WCGS. Three bulb dosimeters are used per site to generate an average quarterly reading per site. The dosimeters are contained in specially constructed PVC plastic holders suspended approximately one meter above the ground. KDHE staff exchange TLDs quarterly. KDHE has collocated TLDS with WCNOC at fourteen sites.

D. Special Precautions during sample collection:

1. Insect pests such as ants and spiders may be present during radiation dosimeter collection.

2. Poison Ivy may be present near some of the collection sites

E. Equipment Requirements

Equipment necessary for radiation dosimeter exchange includes:

1. State of Kansas TLDs in PVC holders (the TLDs are annealed prior to packaging using Procedure RCP/ERS-014: TLD Reader Operation, Maintenance, and Calibration) with three TLDs in each PVC holder
2. Spare gripper clips (0.750 to 1.125 inch) with lanyards for mounting PVC

holders

3. TLD exchange checklists, RCP/ERS-001-FORM 1 /FORM 2

4. Coffey County highway map showing direct radiation monitoring site locations-(optional)

5. Grass/ Hedge trimmers (optional)

F. Procedure

1. Remove the previous quarter's TLD holder and replace with the current quarter's TLD holder. Verify the identification number and location. Ensure that the lanyard is securely attached to the top gripper clip. Verify that the holder is securely mounted. Check the previous quarter's holder for signs of damage or tampering. Search the area throughly in an attempt to find any missing TLDs. Document any unusual findings.

2. Trim any vegetation away from the mounted holder.

3. Return the TLDs to the Radiation Control Program office for processing when all holders have been exchanged.

4. The current quarter's control TLD accompanies the field TLDs during placement and is exchanged with the previous quarter's shielded control TLDs upon return to the Radiation Control Program office. Reunite the previous quarter's control TLDs with the exchanged TLDs.

5. Process the TLDs within three working days after collection using Procedure RCP/ERS-014.

6. Deviations from the procedure are to be documented.

G. Direct Radiation Monitoring Locations:

Refer to the *Wolf Creek Generating Station Environmental Radiation Surveillance Program* for the current State fiscal year for a map of direct radiation monitoring sites. A detailed highway map of Coffey County is maintained and is available for use during TLD collection. Brief descriptions of the TLD locations are found in the TLD exchange checklist for dosimetry located in the environs surrounding the WCGS, RCP/ERS-001-FORM 1. The TLDs are listed in order of pickup using the most direct driving route. It takes about three hours for a person who is familiar with the TLD locations for the exchange. Special placement TLDs are also found in the Curtis State Office Building at 1000 SW Jackson Street, Topeka, Kansas. These TLDs include the control dosimeters and are found in the TLD exchange checklist, RCP/ERS-001-FORM 2. The listing below shows the Kansas site

ID number followed by the historical EP sector designator with the bearing and distance from WCNGS. The positional data for WCNGS is from NRC data as of 6/30/00. Individual TLD site locations were plotted using the Garmin GPS III+ receiver. The map datum used was WGS - 84.

1. KS-1, A-1-005-1.5 (A.0.1)

The site is on a utility easement. This property is owned by WCNOC and is **collocated** with WCNOC. The TLD is on a utility pole that has been cutoff on the north side of the road just east of the intersection of Oxen Lane and 16th Road. This is the old Herman residence.

2. KS-2, A-2-000-2.6 (A.1.1)

The site is on a utility easement. The TLD is located across the road from the Price residence on a utility pole. The Price residence, 1520 17th Ter., is the first house on the right when you drive to the Sharpe air sampler.

3. KS-3, A-3-350-11.6

The site is at the forward staging area, a roadside park, near the intersection of Highway 75 and 26th Road.

4. KS-4, B-1-026-2.7 (B.1.1)

This property is owned by Charles H. Wainscott and is leased to Jim Young, 2349 20th Road, Waverly. This site is on 17th Road about halfway between Planter Road and Quail Road on the north side of the road. There is a red barn and two sheds on the property. The TLD is on a utility pole by the sheds.

5. KS-5, B-2 -025-11.4(B.3.1) *CONTROL*

The site is on a utility easement. The TLD is located by a nursing home on a utility pole off Water Street in Waverly.

6. KS-6, C-1-042-1.9 (C.0.1)

The site is on a utility easement. This property is owned by Milford A. Draper, 1655 16th Road, northeast Burlington. The residence is the first house east of the T-intersection of 16th Road and Planter Road. The TLD is located on the utility pole nearest 16th Road.

7. KS-7, D-1-059-2.0 (D.1.1)

This site is on a utility easement and is **collocated** with WCNOC. The property is owned by Robert Wilkerson, 1571 Quail Lane, southeast Burlington. The site is 0.25 miles south of the intersection of 16th Road and Quail Lane on the east side of the road. The TLD is located on a utility pole by the mailbox.

8. KS-8, E-1-086-1.8 (E.1.2)

This site is on a utility easement. The property is owned by Duane Gifford, 1485 Quail Lane, southeast Burlington. The site location is 0.25 miles south of the intersection of 15th Road and Quail Lane, just north of the driveway on the east side of the road. The TLD is located on a utility pole.

9. KS-9, F-1-116-1.7 (F.0.1)

The site is on a utility easement. The TLD is located on a utility pole across from the Finical residence which is the first house west of the intersection of 14th Road and Quail Lane.

10. KS-10, G-1-135-2.5 (G.1.1)

This property is owned by WCNOC and is **collocated** with WCNOC. The site is located at the end of the road just west of the intersection of 13th Road and Reaper Road. The TLD is attached to the WCNOC property gate fencepost.

11. KS-11, H-0-163-0.8 (H.0.1)

This site is located inside the WCNOC fence line and is **collocated** with WCNOC. A WCNOC person is required to accompany you while on their property. The TLD is located approximately half way down baffle dike A of the Coffey County Lake (CCL), attached to the fence.

12. KS-12, H-1-155-3.1 (H.1.2)

This property is owned by Stan Wahlmeier, 1711 12th Road, Burlington. The site is on 12th Road at the curve just east of the CCL dam (near the air sampler). The TLD is located on a utility pole by the white house, just off the driveway.

13. KS-13, H-2-163-10.3 (H.3.1) *CONTROL*

The site is on a utility easement. The property owner is Inez M. Flake, 1950 Main Street, LeRoy. The site is located just south of the southeast corner of

Main Street and 5th Road (Judkins Street). The TLD is located on a utility pole.

14. KS-14, J-1-176-4.0 (J.1.4)

The TLD is located on a telephone pole across from the driveway of the John Webber residence.

15. KS-15, K-1-213-2.6 (K.1.1)

The site is on a utility easement and is **collocated** with WCNOC. This property is owned by Phyllis Wing, 1439 12th Lane, southeast Burlington. The site is located about 0.25 miles east of the intersection of 12th Lane and Native Road. The TLD is on a utility pole at the driveway entrance.

16. KS-16, L-1-232-2.1 (L.1.1)

This property is owned by Marvin Withers, 1339 Native Road, southeast Burlington. The site is located about 0.5 miles south of the intersection of 14th Road and Native Road. This site is **collocated** with WCNOC. The TLD is on a utility pole located between the two driveways next to the road.

17. KS-17, L-2-229-3.5 (L.1.3)

This property is owned by the First Baptist Church, 1101 North 4th Street, Burlington. The pastor is Reverend Mark Cliffton. The site is located north of the back of the parking lot, between the Sonic and the Church. The TLD is located on the same utility pole as the air sampler.

18. KS-18, L-3-216-4.9

The site is at the Coffey County shop located in Burlington. The TLD is located on a utility pole near the shop entrance.

19. KS-19, M-1-252-2.4 (M.1.2)

This property is owned by Carl Zscheile, 1321 14th Road, southeast Burlington. The site is located 0.25 miles east of the intersection of Highway 75 and 14th Road. This site is **collocated** with WCNOC. The TLD is located on a utility pole at the driveway entrance on the east side, just off the road.

20. KS-20, N-1-270-1.7 (N.0.1)

The site is located on a utility easement and is owned by WCNOC. The site is located about 0.25 miles south of the intersection of 15th Road and Native Road. The TLD is located on a utility pole inside of the pasture gate on the west side of the road.

21. KS-21, P-0-285-0.7 (P.0.1)

This site is located inside the WCNOC fence line and is **collocated** with WCNOC. A WCNOC person is required to accompany you while on their property. The TLD is located on the north side of baffle dike B of the CCL, at the bend and about half-way down the rip-rap (beware of ice in the winter).

22. KS-22, P-1-300-2.9 (P.1.1)

This site is on a utility easement. The property is owned by George Smith, 1255 16th Road, northeast Burlington. The site is **collocated** with WCNOC. The TLD is on a utility pole that is located about 300 feet east of the intersection of Highway 75 and 16th Road on the south side of the road, near the RWD No. 5 water tower (just as you are entering New Strawn).

23. KS-23, P-2-289-15.4 (P.3.1) *CONTROL*

This site is located on a utility easement. The property is owned by the City of Hartford. The site is **collocated** with WCNOC and is located behind the fire department. The TLD is on the same utility pole as the air sampler.

24. KS-24, P-3-278-1.7 (P.0.2)

This property is owned by WCNOC. The site is located at the corner of 15th Road and Native Road on the west side of the entrance to the CCL public fishing area (be careful of the barbed wire). The site is **collocated** with WCNOC. The TLD is located on a fencepost.

25. KS-25, P-4-284-1.6

Property is owned by WCNOC. The site is located at the CCL public fishing area near the MUDS structure. The site is **collocated** with WCNOC. The TLD is located on the fence.

26. KS-26, P-5-282-3.6

Site is located at the JRR dam-site public use area, just off Embankment

Road. The TLD is located on a utility pole at the entrance.

27. KS-27, Q-1-314-2.4 (Q.1.1)

The site is located on a utility easement across from property owned by Harold Hess. The house is the last one on the east side of Milo Lane approximately 0.5 miles south of the EOF. The TLD is located on a utility pole.

28. KS-28, R-0-341-0.8 (R.0.1)

This site is on WCNOC property and is **collocated** with WCNOC. Follow the road straight in from the Stringtown cemetery entrance. The TLD is located on a steel post at the CCL shoreline (there is a lot of brush to wade through).

29. KS-29, R-1-339-2.0 (R.1.1)

This property is owned by WCNOC and the site is **collocated** with WCNOC. The site location is about 0.5 miles south of the intersection of 17th Road and Native Lane, at a brick house on the west side of the road. The TLD is located on the same utility pole as the air sampler.

30. KS-30, R-2-328-3.0 (R.1.2)

This property is owned by WCNOC and the site is **collocated** with WCNOC. The site is known as the Environmental Education Area (EEA) and is located 0.25 miles east at the corner of 17th Road and Milo Lane (EOF). The TLD is located just north of the restrooms, on a utility pole.

31. KS-31, R-3-334-4.9

Site is at the Coffey County Airport, just off Highway 75 and 19th Road. The TLD is on a utility pole near the airport entrance.

H. Forms

1. RCP/ERS-001-FORM 1, TLD exchange checklist for dosimetry located in the environs surrounding the WCGS.

2. RCP/ERS-001-FORM 2, TLD exchange checklist for dosimetry located at 1000 S Jackson, Suite 310

Air Sample Collection: Airborne Pathway

A. Purpose

The purpose of this procedure is to outline the surveillance activities for determining the concentrations of atmospheric radioactivity in the environment surrounding the Wolf Creek nuclear-powered generating station (WCGS).

B. Applicability

The activities in this procedure are performed by Kansas Department of Health and Environment staff. There are no specific personnel qualifications associated with this section. Personnel counting sample filters should be familiar with radiation monitoring equipment.

C. General Description

Low-volume regulated air samplers (30 LPM) are used in the WCGS Environmental Radiation Surveillance Program for continuous low-volume air sampling. The air sample media consists of a particulate filter and a charcoal cartridge assembled in a sampling head. The sampling heads are changed weekly. The particulate filter and charcoal cartridge[1] from each sampling head are returned to the DHEL Radiochemistry Laboratory for analysis. Gamma-isotopic analysis are done on the charcoal cartridges and particulate filters.

Air samplers are changed out about every six months and are calibrated annually (Procedure RCP/ERS-013). Maintenance is performed as needed and as directed by unit technical manuals and RCP/ERS procedures.

D. Special precautions during sample collection:

1. High winds may cause the air sampling housing to inadvertently slam shut causing severe head injury. A cotter pin or bolt is available in each housing to secure the lid during high winds.

2. Insect pests such as wasps and spiders may be present inside the air sampling housing.

3. Energized equipment is a potential shock hazard during wet weather.

E. Equipment Requirements

Equipment necessary for air sample collection includes:

1. Field notebook with a Wolf Creek air sampler data collection worksheet for each location monitored (RCP/ERS-002-FORM 1).

2. Business-size envelopes with Wolf Creek air sample collection summary information attached to or printed on the envelope (RCP/ERS-002-FORM 2)

3. Round 47 mm (2.0 in.) glass fiber filters

4. Glassine envelopes (for the filters)

5. TEDE impregnated Charcoal cartridges (Hi-Q™ TC- 30 or equivalent)

6. Whirl-Pak® bags (18 oz.) or small (sandwich size) zipper closure bags (For the charcoal cartridges).

7. Transport case containing air sampling heads, key to air sampler housings, a flat blade screwdriver, tweezers, calculator, pen, and permanent marker

8. A spare air sampler

9. Count rate meter(s) with a thin window 'pancake' β/γ detector and a NaI 1"x1" gamma detector. The count rate meter used with the NaI detector should be capable of gamma energy discrimination and adjusted to detect ^{131}I equivalent gamma energies.

F. Preparation

1. Label 5 charcoal cartridges with each sample location and date one week in advance.

2. Label 5 glassine envelopes with sample location and sample collection date.

Note:
Before loading the air sampling heads, check the integrity of the O-rings. Each air sampling head has three O-rings. The O-rings should be pliable. Cracked O-rings should be replaced.

3. Load the air sampling heads. Inspect the filters for holes or tearing. Do not use the filter if holes or tearing is noted. Place the filter with the matte side facing out. Verify that the cartridge and sampling head have the same

location designation. Place the cartridge in the sampling head with the arrow pointing in the direction of the air flow.

4. Place the loaded air sampling heads in the transport case. Verify that the transport case has all necessary equipment.

Note:

Before starting the sample run, response check the count rate meter(s) and set the timepiece being used for logs to the time reported by the local weather station.

G. Procedure

1. Unlock and open the sample station housing.

2. Record the time, the elapsed time meter reading, and the flow rate on the data collection worksheet. Flow rates should be read from the bottom of the ball. If the elapsed time meter has failed, the clock time will be used to calculate the total flow. (If the timer has failed the unit should be replaced as soon as practical.)

3. Remove the existing air sampling head assembly at the quick-disconnect and replace it with the pre-loaded head assembly. (It is not necessary to turn the air sampler off to change the head assembly).

Notes:

Any unusual conditions with the air sampler, sampling media, power, etc. should be noted in the log.

Any corrective actions that the sampling personnel are capable of making should be done on site.

Spare fuses for the housing power are available but should only be changed if the cause of the blown fuse is known and has been corrected.

If power has been lost to a shared location, contact WCNOC environmental personnel as soon as practical.

Use the Spare air sampler to replace a unit taken out of service. A new log sheet shall be started for the new air sampler.

4. Record the beginning flow rate on the data collection worksheet.

Note

If the beginning or ending flow rates are greater than 5 lpm from the calibrated flow rate OR if the difference between the two flow rates is greater than 7.5 lpm the unit should be placed out of service and replaced.

5. Close and lock the air sampler housing. Verify the lock is engaged by pulling on the lock.

6. Measure and record:
   a. the gross β/γ count rate on the filter
   b. the gross equivalent ^{131}I gamma count rate of the charcoal cartridge.

The remaining steps may be performed after all the samples have been collected.

7. For each location sampled, calculate the volume of air sampled.
   a. If the beginning and ending flow rates (as read on the pump flowmeter) were within 2.5 lpm of the calibrated flow rate, use the calibrated flow rate to calculate the sample volume. Otherwise:
   b. use the average measured flow rate multiplied by the sampler's calibration factor.
   c. Record the results on the data collection worksheet.
   d. Compare the elapsed time meter delta with the clock time delta. The agreement normally is within 2 %. Note any large discrepancies between the elapsed time meter and clock time delta. If the elapsed time meter has failed, then the clock time is used. If it appears that power may have been interrupted, use the time shown by the meter.
   e. Record pertinent comments on the data collection worksheet.

8. For each air sampling head,
   a. Inspect the particulate filters for holes and tearing before removing them from the air sampling heads.
   b. Remove the particulate filter from the air sampling head with tweezers and place in the pre-labeled glassine envelopes. Verify that the location designation on the air sampler head matches that on the glassine envelope.
   c. Remove the charcoal cartridge from the air sampler head and place in a *Whirl-Pak*® bag.
   d. Place the glassine envelopes in the pre-labeled business envelope and record date, time, and volume information on the envelope.
   e. Return the air sampling head to the transport case.
   f. Record comments on the data collection worksheet.

9. Record sample collection information on RCP/ERS-012-FORM 1.

10. Place the business envelope and the charcoal cartridges in a large zipper closure bag. Transport the samples with the sample collection form, to the DHEL Radiochemistry Laboratory. Transfer sample custody to laboratory personnel using the block provided on the sample Collection/custody form.

11. Deviations from the procedure are to be documented.

H. Air Sampler Locations

Refer to the *Wolf Creek Generating Station Environmental Radiation Surveillance Program* for the current State fiscal year. A detailed highway map of Coffey County and a current Rural Directory are available for use during air sample collection. The suggested driving route is Hartford (P-2), Sharpe (A-1), East of the Wolf Creek Lake Dam (H-1), Burlington (L-1), and New Strawn (P-1).

1. WCA A-1 (003-2.7) Sharpe
   R16E, T20S, Section 30, E. Ottumwa Twp. N38° 16' 40.3" W95° 41' 12.0" (WGS 84)

   Located at the easement on a utility pole north side of the road leading to the grain elevator. This site is collocated with WCNOC. A WCNOC TLD is also located at this site. Soil and pasturage samples are obtained near this site.

2. WCA H-1 (157-3.1) East or the Coffey County Lake (CCL) dam
   R16E, T21S, Section 28, Star Twp., N38° 11' 53.2" W95° 40' 02.5" (WGS 84)

   Located on the east shore of the CCL near the curve in 12th Road. WCNOC owns this site. This site is collocated with WCNOC. Soil and pasturage samples are obtained near this site.

3. WCA L-1 (229-3.5) Burlington
   R14E, T21S, Section 23, Burlington Twp., N38° 12' 19.4" W95° 44' 14.8" (WGS 84)

   Located on a utility pole along the north property boundary of the First Baptist Church, near the north parking lot (behind SONIC) at 1101 N 4th Street in Burlington (Pastor Rev. Mark Giffton, Ph. (316) 364-2910). A State of Kansas TLD is also located at this site.

4. WCA P-1 (300-3.1) New Strawn
   R15E, T20S, Section 34, E. Ottumwa Twp., N38° 15' 40.8" W95° 44' 19.7" (WGS 84)

   Air sampler is on a utility pole located on a frontage road easement across from Casey's General Store (west side of Highway 75). This site is collocated with WCNOC. A WCNOC TLD is also located at this site.

5. WCA P-2 (289-15.4) Hartford *CONTROL*
   Lyon County, N38° 18' 32.7" W95° 57' 31.0" (WGS 84)

   Located on a utility pole behind the fire station. This site is collocated with WCNOC. TLDs from the State of Kansas and WCNOC are also found at this site.

I. Forms

1. RCP/ERS-002-FORM-1, Wolf Creek air sampler data collection manual work sheet.

2. RCP/ERS-002-FORM 2, Wolf Creek air sampler collection summary information.

3. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form, modified for the collection of Wolf Creek Air samples (particulate filters and associated charcoal cartridges).

Notes: [1] : Particulate filters: 47 mm diam., Borosilicate glass fiber paper. Class AE. High flow, high loading capacity. DOP test efficiency of at least 99.99 % for 0.3 micron particles.

: Charcoal Catridges: 2.25" x 1.0", 5 % TEDE (Triethylene di Amine) impregnated activated charcoal. 20 x 40 mesh. 98.9% minimum iodine retention at 2.0cfm.

Soil Sample Collection: Airborne Pathway- Deposition

A. Purpose

The purpose of this procedure is to outline the surveillance activities for determining the concentrations of soil radioactivity in the environment surrounding the Wolf Creek Nuclear Generating Station (WCGS).

B. Applicability

The activities in this procedure are done by Kansas Department of Health and Environment Radiation Control Program staff. There are no specific personnel qualifications associated with this section.

C. General Description

Soil samples are collected from trending locations and from random locations throughout the WCGS Ingestion Pathway Zone. A gamma isotopic analysis is done on each sample collected. Strontium analyses are done on selected samples.

D. Sample Frequency

1. Samples will be collected annually from each trending location listed in section (H.) of this procedure.

2. Random samples will be collected from locations within the WCGS IPZ each State Fiscal Year (SFY) as outlined in that year's ERS Program plan. These locations should be concentrated in, but not restricted to, the primary downwind sectors (P-C and G-K) and within the 10-mile EPZ. The sample collection effort should be distributed over the year to reduce stress on manpower and laboratory resources.

E. Special Precautions:

1. Insect pests such as ticks and chiggers may be present during sampling. Use of an insect repellant containing DEET is highly recommended.

2. Use of a sun screen is highly recommended. Consideration may be given to collecting samples before 1000 or after 1400 to reduce the intensity of exposure to the sun.

3. Be aware of livestock and pets in the sampling areas.

F. Equipment Requirements:

Equipment necessary for soil sample collection includes:

1. Trowel, sample scoop or putty knife
2. Soil Core Sampling tool
3. Ziplock bags or wide mouth polyethylene containers ($\geq$ 1 ℓ)
4. An indelible marker
5. Portable GPS Unit.
6. A notebook (optional)
7. Area template or tape measure

   Area templates available:

Diameter, m	Area, m^2
0.20	0.03
0.31	0.07
0.38	0.11
0.48	0.18

8. De ionized water ($\geq$ 3.8 ℓ)-(optional)
9. Paper towels (optional)

G. Procedure:

1. Find a sample collection area with little vegetation present and at least 100 m^2 in area, away from buildings and trees, that has not been recently broken or cultivated.

2. Site location logging:
   a. For trending locations, locate the sample site using the GPS unit. the site shall be within 50 meters (164 ft.) of the **historical location**. Log the GPS coordinates.

   b. For random locations, enter a waypoint in the GPS memory. Note the waypoint number and set the waypoint to averaging while collecting the sample. Record the GPS coordinates after the sample is collected. For greater accuracy, allow the unit to average for at least three minutes.

3. Collection: Soil collected is placed in the ziplock bag or the wide-mouthed polyethylene container.

   a. For trending locations:
   Using a trowel, sample scoop or putty knife, randomly collect samples within the chosen area. Soil is collected to a depth of approximately 1 cm until a total sample volume of at least One liter has been collected. Area templates are available ranging from 0.03 to 0.18 m^2 to aid in estimating the surface area of collection.

   b. *For random locations:*
   Using the core sampling tool, randomly collect sample 'plugs' within the chosen area. Soil is collected to a depth of approximately 3 to 6 inches until a total sample volume of at least One liter has been collected. Use the tool diameter to estimate the sample area and the depth to calculate the sample volume.

Note:
A transfer container may be used for initial collection to simplify sorting and cleaning the sample.

4. Remove any debris, such as sticks, excess vegetation and rocks. Break up any clumps and mix the soil. Minimum sample volume must still be met after cleaning. Samples that are to be shared will be split *after* the sample has been cleaned and mixed.

5. Clean the sampling tools after each sample collection.

6. Record the time, date, and sample collection location on the outside of the sample collection container. Record sample collection information on the Laboratory Collection/custody Sheet (RCP/ERS -012-Form1). Locations will be identified with the following ID formats:

Trending Locations:
WCS -(sector)-(historical reference #)
(Ex.: WCS-A-1)
Random Samples:
WCRS-##(sequential number)-(sector)-(bearing from WCNOC ref.)-X.X (miles from WCNOC ref.)
(Ex: . WCRS-01-R-330-4.5)

7. Transport the samples with the sample collection form to the DHEL Radiochemistry Laboratory. Transfer sample custody to the laboratory personnel using the Laboratory Collection/custody Sheet (RCP/ERS -012-

Form1).

8. Abide by any oral or written instructions given by property owners when collecting samples on private property.

9. Deviations from the procedure are to be documented.

H. Soil Sample Locations

Refer to the *Wolf Creek Generating Station Environmental Radiation Surveillance Program* for the current State fiscal year. A detailed highway map of Coffey County is maintained and is available for use during soil sample collection.

1. WCS A-1-005-2.5 (A.0.1) North of WCGS
   R16E, T20S, Section 31, E. Ottumwa Twp., N38 16 28.4 W95 41 04.9 (WGS 84)

   Sample location is approximately 1.7 miles north of WCGS, near 16th Road and Oxen Lane, on WCNOC property. A State of Kansas and WCNOC TLD is also at this site.

2. WCS E-1-087-5.8 (E.2.1) Scott Valley Church, *CONTROL*
   R17E, T21S, Section 6, Star Twp., N 38° 14' 34" - W 95° 34' 55" (WGS 84)

   The pastor is Rev. Ken Davidson. The caretaker is Maxine Payer, 2365 13th Road, southeast Westphalia (Ph. 316-489-2473).

3. WCS H-1-157-3.1 (H.1.3) Near Salava's pond
   R16E, T21S, Section 28, Star Twp., N38 11 53.0 W95 40 02.0 (WGS 84)

   Sample location is approximately 3.5 miles southeast of WCGS, across the road from the Logan cemetery. Property is owned by James H. Salava, 1876 10th Road, southeast Burlington (Ph. 316-363-2205). This location is also a historical surface water sampling site. Alternate site is near the air sampler, located east of the Coffey County Lake (CCL) dam.

4. WCS P-1-289-1.6 (P.0.2) CCL public access fishing area
   N38 14 46.9 W95 42 57.4 (WGS 84)

   Sample location is near the makeup discharge structure (MUDS), approximately 2 miles east of the WCGS. Property is owned by WCNOC, and is a split sample location. Pasturage, shoreline sediments and aquatic vegetation are also collected at this site. A WCNOC and State of Kansas TLD are also at this site.

5. WCS R-1-330-2.9 (R.1.2) CCL Environmental Education Area (EEA).

N38 16 32.7 W95 42 57.2, (WGS 84)

Sample location is approximately 3.5 miles north northeast of the plant, north of the EOF. Property is owned by WCNOC, and is a split sample location. Pasturage, shoreline sediments and aquatic vegetation are also collected at, or near, this site. A WCNOC and State of Kansas TLD are also at this site.

I. Forms

1. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form.

Surface Water Sample Collection

A. Purpose

The purpose of this procedure is to outline the surveillance activities for determining the concentrations of surface water radioactivity in the environment surrounding the Wolf Creek Nuclear Generating Station (WCGS).

B. Personnel

The activities in this procedure are done by Kansas Department of Health and Environment staff. No specific personnel qualifications are associated with this section.

C. General Description

Surface water samples are collected either on a monthly or annual frequency. A sample is collected from New Strawn City Lake annually. All other samples are collected monthly [Note 1]. A gamma isotopic analysis is done on each water sample collected. All samples are also analyzed for tritium (^{3}H).

D. Special precautions during sample collection

1. Wildlife such as snakes and snapping turtles may be present at some sample collection sites.

2. Insect pests such as ticks and chiggers may be present during sampling. Use of an insect repellant containing DEET is highly recommended.

3. Extremely cold temperatures during winter may occur. Dress accordingly and protect face and hands.

4. During warm weather, humidity levels approaching 100% may exist along the banks of creeks and rivers. Take precautions against heat stress.

5. It is recommended that when sampling during periods of extreme heat or cold, that a buddy system be incorporated.

E. Equipment Requirements

Equipment necessary for surface water collection includes:

1. Labeled, wide mouth sampling containers, one gallon (4 liters) minimum capacity each.

2. A plastic or metal bucket. *Note: a separate bucket is used for surface water samples collected in the Coffey County Lake (CCL). This is to prevent cross-contamination of other samples with possible reactor plant contaminants.*

3. RCP/ERS-012-FORM 1, Radiochemistry Laboratory Collection/custody form.

4. A notebook (optional).

5. Funnel-(optional).

6. Rope(optional).

7. An extendable pole(optional).

F. Procedure

Sample collection may be done at the shoreline if the water is deep enough to avoid disturbing sediments and aquatic vegetation. If the water is too shallow at the shoreline, the sample may be collected with an extendable pole or rope attached to the bucket. If an extendable pole or rope is unavailable, the sample may be collected by donning hip waders and proceeding to deeper water.

For each location:

1. Rinse the bucket and sample container *at least twice* with water to be sampled. Dispose of rinse water in an area away from the location where the sample is to be collected.

2. Collect the sample in the bucket. Care should be taken to disturb the water's surface as little as possible. The water should be taken from close to the surface, no more than 10 inches deep, and transferred into the sample container.

3. Record sample collection information on the Laboratory Collection/custody form, RCP/ERS-012-FORM 1.

4. Samples will be transported to the DHEL Radiochemistry Laboratory. Transfer sample custody to the laboratory personnel with the Laboratory Collection/custody form.

5. Deviations from the procedure are to be documented.

G. Surface Water Sample locations

Refer to the *Wolf Creek Generating Station Environmental Radiation Surveillance Program* for the current State fiscal year. A detailed highway map of Coffey County is maintained and is available for use during soil sample collection.

1. WCSW P-1-297-3.3 (P.1.2) New Strawn City Lake
   N 38° 15' 39.1" W 95° 44' 37.5", (WGS 84)

This property is located in New Strawn and is owned by the City of New Strawn. This is a public access lake (pond) and is periodically stocked with fish.

2. WCSW J-1-168-3.2 (J.1.1) CCL Spillway
   N 38° 14' 31.3" W 95° 45' 15.6", (WGS 84)

Note 1: *WCSW location J-1 will be sampled only if CCL level has caused flow over the spillway during the last 30 days or at the request of WCNOC. If there has been flow, but there is no flow on the sample day, then the sample will be taken from the outlet pool or at the Wolf Creek bridge on SE 11th Rd.*

The site is owned by WCNOC. This is the last "on property" surface water sample collected before lake water re-enters Wolf Creek.

3. WCSW N-1-274-3.6 (N.1.2) John Redmond Reservoir*CONTROL*
   R15E, T21S, Section 4, Burlington Twp., N 38° 14' 28.2" W 95° 41' 55.9", (WGS 84)

The sample is collected below the outfall on the north side of the river near the CCL MUSH (make-up Screen House). The site is on federal property. Samples are split with WCNOC.

4. WCSW Q-1-286-0.6 (Q.0.1) CCL Discharge Cove
   N 38° 11' 35.3" W 95° 40' 35.2", (WGS 84)

The site is owned by WCNOC. Samples are collected off Baffle Dike B near the WCGS discharge point at the metal walkway.

H. Forms

1. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form.

Ground Water Sample Collection: Waterborne Pathway

A. Purpose

The purpose of this procedure is to outline the surveillance activities for determining the concentrations of ground water radioactivity in the environment surrounding the Wolf Creek nuclear-powered generating station (WCGS).

B. Applicability

The activities in this procedure are done by Kansas Department of Health and Environment staff. No specific personnel qualifications are associated with this section.

C. General Description

Ground water samples are collected annually. All water samples collected are analyzed for gross alpha, gross beta, and tritium (^{3}H). A gamma isotopic analysis is also done on each water sample collected.

D. Special precautions during sample collection:

1. Insect pests such as wasps and spiders may be present inside water outlets or pump housings.

2. Some sites occasionally have foul-smelling water during the initial flush of the system. Consideration may be given to wearing gloves during sampling with hand washing done after the sample is collected.

3. Energized equipment is a potential shock hazard during wet weather.

E. Equipment Requirements

Equipment necessary for ground water collection includes:

1. Wide mouth sampling containers, 4 liter minimum capacity each

2. A plastic or metal bucket

3. Tape or sample collection tags
4. Funnel-optional

5. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form

F. Procedure

1. Purge water the line for approximately one minute before taking the sample. Rinse the bucket and sample container at least twice with water to be sampled. Dispose of rinse water in an area away from the location where the sample is to be collected. The sample may be collected directly in the sample container or collected in the bucket and transferred into the sample container.

2. Record the time, date, and sample collection location on the outside of the wide mouth sampling container. Record sample collection information on the sample collection form to the DHEL Radiochemistry Laboratory.

3. Transport the samples with the sample collection form to the DHEL Radiochemistry Laboratory. Transfer sample custody to the laboratory personnel using the sample Collection/custody form.

4. Abide by any oral or written instructions given by property owners when collecting samples on private property.

5. Deviations from the procedure are to be documented.

G. Ground Water Sample locations

Refer to the *Wolf Creek Generating Station Environmental Radiation Surveillance Program* for the current State fiscal year. A detailed highway map of Coffey County is maintained showing all environmental radiation surveillance sampling locations and is available for use during ground water sample collection. Ground water samples are historically split with WCNOC.

1. WCGW B-1-028-1.9 (B.0.1) *CONTROL*
R16E, T20S, Section 32, N38 15 45.7 W95 40 23.2, (WGS 84)

   Property is owned by Larry Hess (KDHE BOW Ext. 6-5570). The site is located about 0.5 mile east and 0.5 mile north of the intersection of Planter Road and 16th Road. This is the first intersection north of WCGS. The hand-pump is in a field on the east side of the road at an abandoned trailer house site. This well is in poor condition and the water frequently has a foul odor.

2. WCGW J-1-185-3.8 (J.1.3)

R16E, T21S, Section 31,N38 11 01.5 W95 41 38.9, (WGS 84)

Property owned by Vernon D. Ritter, 1549 11th Road, SE Burlington. The site is at the southwest corner of Oxen Lane and 11th Road. The pump is electric and is located south of the white house. The faucet is located at the corner of the barn.

3. WCGW L-2-218-2.8 (L.1.2) Garrett's Residence
R15E, T21S, Section 23, N38 12 23.0 W95 43 15.0, (WGS 84)

Property is owned by James Garret, 1250 Native Road, SE Burlington. The sample point is a faucet, located at the rear of the Garrett home, which is a brick house at the T-intersection of Native Road and 12th Lane. This well serves as the water supply for the household. This is the only monitored ground water site used for drinking water.

4. WCGW N-1-266-2.7(N.1.1) Wagner's residence
R15E, T21S, Section 10, N38 14 10.2 W95 44 20.7, (WGS 84)

Property is owned by Roger Wagner, 1460 HWY. 75, Burlington. The house is about 1 mile north of the Neosho River bridge and is on the west side of Highway 75. The sample point is the small pump house near the barn. The water from this site is used for livestock. The pump is electric. The pump switch is located in the small pump house.

H. Forms

1. RCP/ERS-012-FORM 1, Kansas Department Health and Environment Radiochemistry environmental radiation surveillance sample Collection/custody form.

Sediment Sample Collection: Waterborne Pathway

A. Purpose

The purpose of this procedure is to outline the surveillance activities for determining the concentrations of sediment radioactivity in the environment surrounding the Wolf Creek nuclear-powered generating station (WCGS).

B. Applicability

The activities in this procedure are done by Kansas Department of Health and Environment staff. No specific personnel qualifications are associated with this section.

C. General Description

Sediment samples are collected from trending locations and from random locations on Coffey Co. Lake and downstream of CCL on the Neosho River and Wolf Creek. Random sediment locations may be bottom ***or*** shoreline. Random samples will be collected from locations as outlined in that year's ERS Program plan. A gamma isotopic analysis is done on each sample collected. Selected samples are analyzed for Strontium.

D. Special precautions during sample collection:

1. Wildlife such as snakes and snapping turtles may be present at some sample collection sites.

2. During warm weather, high humidity levels may exist along the banks of creeks and rivers. Use proper precautions for heat stress.

3. Use of the buddy system is recommended.

4. Bottom Sediment samples may be collected using a boat. All boating safety regulations apply, especially the wearing of proper flotation devices. Sample collection from the boat will not be done during periods of high winds or approaching storms. Personnel should have attended USCG or USACOE approved boating safety courses.

5. The sampling dredge used by Wolf Creek for bottom sediment collection is heavy and may cause serious injury to the hands or fingers if not operated properly. Gloves should be worn when handling the sampling dredge or

ropes.

E. Equipment Requirements

Equipment necessary for sediment sample collection includes:

1. A trowel or putty knife.
2. A Ponar® Bottom sediment sampler or equivalent.
3. A plastic or metal bucket.
4. A funnel.
5. Ziplock bags or wide-mouth polyethylene containers (2 Liter minimum).
6. An Indelible marker.
7. Portable GPS Unit.
8. Hip waders-optional.
9. De-ionized water-optional.
10. Paper towels-optional.
11. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form.

F. Procedure

1. Site location logging:
   a. For trending locations, locate the sample site using the GPS unit. the site shall be within 50 meters (164 ft.) of the historical location. Log the GPS coordinates.

   b. For random locations, enter a waypoint in the GPS memory. Note the waypoint number and set the waypoint to averaging while collecting the sample. Record the GPS coordinates after the sample is collected. For greater accuracy, allow the unit to average for at least three minutes.

2. Bottom sediment sample collection:

Note:

Some bottom sediment sample collection requires the use of a boat (WCNOC provides and operates the boat)-observe all water safety requirements, especially the wearing of proper floatation devices.

a. Using the dredge, pull a sample from the bottom to the surface. Do not pull the dredge up too quickly. This may wash out part of the sample.

b. Allow the water to drain from the dredge. Sediment in the dredge may be transferred to a pre rinsed bucket. Repeat as needed to obtain a minimum of 2 liters of sample.

c. Remove any debris, such as sticks and rocks. Pour off any excess water.

d. Transfer the sediment into the sample container.

e. Clean the dredge, transfer bucket, funnel, etc. after each sample.

3. For shallow lakes, ponds or streams, waders may be used to reach the sample locations. For these locations the dredge may not be practical or safe to use. Samples may be obtained using a bucket, shovel or other hand held sediment sampling tools. Use the applicable the parts of F. 2. above to collect the sample.

4. Shoreline sediment sample collection:

a. Find an area with minimal vegetation and at least ten to fifteen feet long at the waterline.

b. Sample collection is along the lap line (where the waves lap along the shoreline and visible graduations of silt are visible). Using the trowel or putty knife, randomly collect sediment to a depth of approximately 1 cm and place in the sample container. (A clean transfer container may be used) Remove any debris such as sticks and rocks. Continue sample collection until a total sample volume of at least 2 liters has been collected.

c. Clean the tools after each sample.

5. Record the time, date, and sample collection location on the outside of the sample collection container. Record sample collection information on the Laboratory Collection/custody Sheet (RCP/ERS -012-Form1). Locations will be identified with the following ID formats:

Trending Locations:

WCSS (BS)-A(sector)-(historical reference #)

(Ex.: WCSS-AR-1)

Random Samples:
WCRSS(BS)-##(sequential number)-(sector)-(bearing from WCNOC ref.)-X.X (miles from WCNOC ref.)
(Ex: . WCRSS-01-R-330-4.5)

6. Transport the samples with the sample collection form to the DHEL Radiochemistry Laboratory. Transfer sample custody to the laboratory personnel using the sample Collection/custody form.

7. Abide by any oral or written instructions given by property owners when collecting samples on private property.

8. Deviations from the procedure are to be documented.

G. Sediment Sample Trending locations

Refer to the *Wolf Creek Generating Station Environmental Radiation Surveillance Program* for the current State fiscal year. A detailed highway map of Coffey County is maintained and is available for use during sediment sample collection.

1. WCBS/SS AJ-1-178-3.8 (J.1.2) Wolf Creek
R16E, T21S, Section 31, **N38 11 04.6 W95 41 10.1** (WGS 84)

   On Wolf Creek below the Coffey County Lake (CCL) Spillway. The site is below a 11th Road bridge that crosses Wolf Creek about 0.25 miles west of the intersection of Planter Road and 11th Road. (Bearing 175 deg. 3.75 miles from WCGS) This is historically the first “off property” sample location for sediment collection. This location is on an easement.

2. WCBS/SS-AN-1-275-3.8 (N.1.2) JRR above the dam, *CONTROL*
SS-**N38 14 37.9 W95 45 20.3**, BS-**N38 14 37.4 W95 45 28.9**, (WGS 84)

   Access to the site is off Embankment Road at the public use area. Bottom sediment collection is on JRR near the dam (a boat is required). Shoreline sediment is also collected along the shoreline near the dam. These sediment samples are historically split with WCNOC because their boat is used to collect the bottom sediment samples. Aquatic vegetation, if available is also collected at this location. A surface water sample is collected on the Neosho River below the dam. Fish are also collected on the Neosho River below the dam.

3. WCSS/BS AP-1-289-1.6 (P.0.2) CCL public access fishing area
N38 14 46.9 W95 42 57.4, (WGS 84)

Sample location is near the makeup discharge structure (MUDS), approximately 2 miles east of the WCGS. Property is owned by WCNOC, and is a split sample location. Pasturage, soil, and aquatic vegetation are also collected at this site. A WCNOC and State of Kansas TLD are also at this site.

4. WCBS-AQ-1-291-0.8 / WCSS-Q-1-301-0.8 (Q.0.1) CCL Discharge Cove
BS-**N38 14 35.5 W95 42 09.8**, SS-**N38 14 42.4 W95 42 07.8** (WGS 84)

Property is owned by WCNOC, and is a split sample location. Bottom sediment collection is done off baffle dike B (a boat is required). The shoreline sediment sample is collected where a lap line is observed, usually near Stringtown Cemetery. Surface water, fish, and aquatic vegetation sample collection is also done near this site. A State of Kansas and WCNOC TLD is also near this site.

5. WCSS/BS AR-1-332-2.9 (R.1.2) CCL Environmental Education Area (EEA)
N38 16 36.1 W95 42 50.6 (WGS 84)

Sample location is approximately 3.5 miles north northeast of the plant, north of the EOF. The property is owned by WCNOC, and is a split sample location. Soil, pasturage, and aquatic vegetation are also collected near this site. A WCNOC and State of Kansas TLD are also at this site.

6. WCBS AR-2-329-1.0 CCL Discharge Cove
N38.25117 W95.69815 (WGS 84)

Sample location identified by SFY 2001 random sampling. Bottom sediment in CCL DC one mile NNW (bearing 329 degrees) of WCNOC site center near Stringtown Cemetery.

H. Forms

1. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form.

Aquatic Vegetation Sample Collection: Waterborne Pathway

A. Purpose

The purpose of this procedure is to outline the surveillance activities for determining the concentrations of aquatic vegetation radioactivity in the environment surrounding the Wolf Creek nuclear-powered generating station (WCGS). Aquatic vegetation refers to rooted aquatics or algae.

B. Applicability

The activities in this procedure are done by Kansas Department of Health and Environment staff. No specific personnel qualifications are associated with this section.

C. General Description

Aquatic vegetation samples are collected from random and trending locations as described below. A gamma isotopic analysis is done on each sample collected. Strontium analyses are done on selected samples.

D. Sample Frequency

1. Samples will be collected annually from each trending location listed in section (H.) of this procedure. Random samples will be collected each State Fiscal Year (SFY) as outlined in that year's ERS Program plan. These locations should be concentrated in, but not restricted to, CCL and areas within the 10-mile EPZ, downstream of the CCL discharge on Wolf Creek, the Neosho River and their tributaries. The sample collection effort should be distributed over the year to reduce stress on people and laboratory resources.

E. Special precautions during sample collection:

1. Wildlife such as snakes and snapping turtles may be present at some sample collection sites.

2. During warm weather, humidity levels approaching 100% may exist along the banks of creeks and rivers. Depending upon the temperature, heat stress may occur.

3. It is recommended that when sampling during periods of extreme heat that

a buddy system be incorporated.

4. When sampling is being conducted from a boat, observe *all* applicable boating safety rules.

F. Equipment Requirements

Equipment necessary for aquatic vegetation sample collection includes:

1. A trowel or putty knife.
2. Knife, scissors or grass clippers.
3. An Indelible marker.
4. Hip waders.
5. Ziplock bags or wide mouth polyethylene containers ($\geq$ 1 ℓ).
6. Portable GPS Unit.
7. A notebook.
8. De ionized water ($\geq$ 3.8 ℓ)-optional.
9. Paper towels (optional).
10. Spring scale.

G. Procedure

1. Aquatic vegetation includes algae and/or rooted aquatic plants. Samples of both may be composited if necessary. The most common rooted aquatic plants collected include Potamogeton, Arrowhead, and American Lotus. The minimum sample mass required is 500 grams. For rooted aquatics, submerged plants are preferred to dry.

Note:
For all vegetation, a minimum of 200 grams of processed mass is required (dried and powdered) for analysis. Depending upon moisture content, this may correspond to as much as 2,000 grams of raw sample.

2. Site location logging:
   a. For trending locations, locate the sample site using the GPS unit. the

site shall be within 50 meters (164 ft.) of the historical location. Log the GPS coordinates.

b. For random locations, enter a waypoint in the GPS memory. Note the waypoint number and set the waypoint to averaging while collecting the sample. Record the GPS coordinates after the sample is collected. For greater accuracy, allow the unit to average for at least three minutes.

3. Algae collection:
   a. A putty knife may be used to scrape the algae off rocks or other flat surfaces, such as boat ramps.
   b. During peak growing periods, scraping may not be necessary and the collection can be done by hand.
   c. Excess water should be squeezed from the algae.

4. Rooted aquatic vegetation:
   a. Done by hand, using either a boat or hip waders. Rooted aquatic vegetation normally grows in less than a meter of water.
   b. Usually leaves, stems, and roots are collected. **Submerged plants are preferred.**

5. Rinse off all sediments and remove any debris such as rocks and sticks before placing the aquatic vegetation in the sample collection container.

6. Record the time, date, and sample collection location on the outside of the sample collection container. Record sample collection information on the Laboratory Collection/custody Sheet (RCP/ERS -012-Form1). Locations will be identified with the following ID formats:

Trending Locations:
WCRA(AL)-(sector)-(historical reference #)
(Ex.: WCAL-R-1)

Random Samples:
WCRRA(AL)-##(sequential number)-(sector)-(bearing from WCNOC ref.)-X.X (miles from WCNOC ref.)
(Ex: . WCRAL-01-R-330-4.5)

7. Transport the samples with the sample collection form to the DHEL Radiochemistry Laboratory. Transfer sample custody to the laboratory personnel using the sample Collection/custody form.

8. Abide by any oral or written instructions given by property owners when collecting samples on private property.

9. Deviations from the procedure are to be documented.

H. Sample locations

Refer to the *Wolf Creek Generating Station Environmental Radiation Surveillance Program* for the current State fiscal year. A detailed highway map of Coffey County is maintained and is available for use during aquatic vegetation sample collection.

1. WCAL/WCRA J-1-178-3.8 (J.1.2) Wolf Creek
R16E, T21S, Section 31, **N38 11 04.6 W95 41 10.1** (WGS 84)

   On Wolf Creek, below the Coffey County Lake (CCL) Spillway. The site is below a 11th Road bridge that crosses Wolf Creek about 0.25 miles west of the intersection of Planter Road and 11th Road. This is historically the first "off property" sample location for sediment collection. Sediment samples are also collected at this site. Historically, surface water samples and shoreline sediment were also collected at this site. This site has also occasionally been used for fish and invertebrate sample collection. This location is on an easement.

2. WCAL/WCRA N-1-275-3.8 (N.1.2) JRR above dam *CONTROL*
N38 14 37.4 W95 45 28.9 (WGS 84)

   Access to the site is off Embankment Road at the public use area. Algae collection is normally done at the boat ramps. Rooted aquatic vegetation is normally not present. Sediment samples are also collected at this location. An alternate sampling location is on the Neosho River below the dam. Surface water and fish samples are also collected on the Neosho River below the dam.

3. WCAL/WCRA P-1-289-1.6 (P.0.2) CCL public access fishing area
N38 14 46.9 W95 42 57.4 (WGS 84)

   Sample location is near the makeup discharge structure (MUDS), approximately 2 miles east of the WCGS. Property is owned by WCNOC, and is a split sample location. Pasturage, soil, and shoreline sediment samples are also collected at this site. A WCNOC and State of Kansas TLD are also at this site.

4. WCAL/WCRA Q-1316-0.3 (Q.0.1) CCL Discharge Cove
N38 14 33.1 W95 41 35.7 (WGS 84)

   Property is owned by WCNOC, and is a split sample location. Algae collection is normally done at the boat ramp near the discharge structure. Rooted

aquatic vegetation collection is done using a boat. Surface water, sediment, and fish sample collection is also done near this site. A State of Kansas and WCNOC TLD is also near this site.

5. WCAL/WCRA R-1-332-3.0 (R.1.2) CCL Environmental Education Area (EEA)
N38 16 36.1 W95 42 50.6 (WGS 84)

Sample location is approximately three miles north northeast of the plant,
north of the EOF. Property is owned by WCNOC, and is a split sample location. Rooted aquatic plants are usually found on the non developed (East) side of the EEA. Algae are usually not present at this location. Soil and pasturage samples are also collected at this site. A WCNOC and State of Kansas TLD are also at this site.

I. Forms

1. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form.

Drinking Water Sample Collection: Ingestion Pathway

A. Purpose

The purpose of this procedure is to outline the surveillance activities for determining the concentrations of drinking water radioactivity in the environment surrounding the Wolf Creek nuclear-powered generating station (WCGS).

B. Applicability

The activities in this procedure are done by Kansas Department of Health and Environment staff. No specific personnel qualifications are associated with this section.

C. General Description

A raw drinking water sample (prior to chemical treatment) is collected monthly from Le Roy, Kansas. This is the nearest community that is found downstream of the confluence with Wolf Creek and the Neosho River, and that uses the Neosho River as a drinking water source. An automatic composite sampler is used to collect the sample. The samples collected at this location are now collected by WCNOC staff. The ISCO™ sampler that KDHE maintains for this location is a standby sampler and procedure below is for that sampler. WCNOC and KDHE split the samples collected at this location. All water samples collected are analyzed for Tritium (^{3}H). A gamma isotopic analysis is also done on each water sample collected. Analysis for strontium is done on a quarterly composite of monthly samples.

The *control* sampling location is Burlington, KS. This site is monitored by WCNOC. KDHE RCP does not directly sample this location. KDHE BOW also monitors this location and samples are analyzed by the KDHE Radiation Lab. RCP receives a duplicate report with gamma isotopic and Tritium levels as required.

The responsibility for ensuring compliance with drinking water regulations lies with the Bureau of Water. The Wolf Creek Environmental Radiation Surveillance Program requirements do not necessarily ensure compliance with drinking water regulations.

D. Special precautions during sample collection:

1. Water treatment facilities use hazardous chemicals such as Calcium Hypochlorite for water treatment. Be aware of chemical spills, if such exist, do not enter the area.

2. The floors of the facility are periodically hosed down causing a potential

slipping hazard.

3. Use caution when operating electrical equipment in wet environments.

E. Equipment Requirements

Equipment necessary for surface water collection includes:

1. Wide mouth sampling container, 1 gallon (3.8 ℓ) minimum capacity
2. A plastic or metal bucket
3. Tape or sample collection tags
4. Funnel-optional
5. A composite water sampler

F. Procedure

The Radiation Control Program maintains a Model 2700 ISCO™ Water Sampler at the nearest downstream location that uses the Neosho River as a drinking water source (currently LeRoy, KS). The sample point is untreated water obtained from the Water Treatment Plant settling basin. Should it become necessary to collect additional grab samples, they may be obtained at the settling basin or collected from a tap somewhere in the distribution system.

1. The sample may be collected directly in the sample container if obtaining a sample from the tap. Purge the line for approximately one minute prior to taking the sample. OR:
2. Collect samples from the settling basin using a bucket and then transferring the water into the sample collection container. Rinse the bucket and sample container at least twice with water to be sampled before collecting the sample.
3. The ISCO™ water sampler is currently set to collect 150 mℓ of water every 12 hours over a 30-day period for a total sample collection of 9 ℓ. Current program settings are as follows:

    a. MODE = 1, COMP TIME
    b. INTERVAL BETWEEN SAMPLES = 720 minutes (12 h)
    c. DELAY TO FIRST SAMPLE = 2 minutes (variable- a short delay allows for the verification of proper operation)
    d. NOMINAL SAMPLE VOLUME = 15 × 10 mℓ

e. TYPE OF SUCTION LINE = 1 (¼ inch I.D., 10 foot length)
f. SUCTION HEAD = 4 feet
g. MULTIPLEX MODE = OFF
h. NUMBER OF COMPOSITE SAMPLES = 60

Notes:
Refer to the operator's manual if any problems develop.

The unit should be rebuilt every two years.

The internal electronics desiccant should be checked during the monthly sample collection. A pink bulls-eye suggests the need for replacement desiccant.

The unit setup should be checked at the sampling location after the unit is rebuilt and before placing the unit back in service.

4. Sample collection involves changing out the ISCO™ sample container or transferring the desired amount of sample to the sample collection bottles, checking case humidity, and resetting the program. If the ISCO™ sample container is not changed out, empty any remaining water before resetting the distributer. Part of the sample is saved monthly for quarterly analysis.

5. Record the collection location on the outside of the wide mouth sampling container. Record sample collection information on the sample Collection/custody form, RCP/ERS-012-FORM 1.

6. Transport the samples with the sample collection form to the DHEL Radiochemistry Laboratory. Transfer sample custody to the laboratory personnel using the sample Collection/custody form.

7. Abide by any oral or written instructions given by property owners when collecting samples on private property.

8. Deviations from the procedure are to be documented.

G. Drinking Water Sample locations

Refer to the *Wolf Creek Generating Station Environmental Radiation Surveillance Program* for the current State fiscal year. A detailed highway map of Coffey County is maintained and is available for use during drinking water sample collection.

1. WCDW H-1 LeRoy

LeRoy water treatment plant. Supplied from the Neosho River, downstream of the confluence with Wolf Creek. This site is collocated with WCNOC. Both WCNOC and KDHE operate an automatic composite water sampler at this location. *The ISCO™ sampler that KDHE maintains for this location is a standby sampler.*

2. WCDW L-1 Burlington *CONTROL*

Burlington water treatment plant. Water is supplied from the Neosho River upstream of the confluence with Wolf Creek. Kansas Bureau of Water personnel collect grab samples at this location. WCNOC also operates an automatic composite water sampler at this location. KDHE ERS does not sample this location. WCNOC provides copies of sample results.

H. Forms

1. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form.

Milk Sample Collection: Ingestion Pathway

A. Purpose

The purpose of this procedure is to outline the surveillance activities for determining the concentrations of raw milk radioactivity in the environment surrounding the Wolf Creek nuclear-powered generating station (WCGS).

B. Applicability

The activities in this procedure are done by Kansas Department of Health and Environment staff. No specific personnel qualifications are associated with this section.

C. General Description

Milk is sampled quarterly from the Coffey County area. Gamma isotopic and a low-level ^{131}I analysis are done on each sample collected. An annual strontium analysis is also done.

D. Special precautions during sample collection:

1. Observe posted or verbal cleanliness requirements if handling dairy equipment.

2. Be aware of livestock.

E. Equipment

Equipment necessary for raw milk sample collection includes:

1. Wide mouth sampling container, 1 gallon (3.8 L) minimum capacity.

2. Tape or sample collection tags.

3. Funnel-optional.

4. Cooler with ice-optional.

F. Procedure

Sampling at dairy will be done by dairy personnel, or under their direction. The general sampling procedure is as follows:

1. Ensure sampling equipment is sanitized per dairy personnel's directions, especially if a sample is to be obtained by dipping.

2. Open the holding tank lid and dip the milk from the holding tank into the sampling container. Use a funnel if necessary. Some holding tanks will have a spigot available for sample collection.

3. Close the lid of the holding tank. If any milk has been spilled, clean/sanitize the area if necessary. Usually a wash down of the area with a hose is sufficient.

4. Place the milk sample in the cooler, if necessary, for transport to the KDHE Radiochemistry laboratory.

5. If the sample is obtained by dairy personnel, or if sampling is done at a private home by a resident:

    a. Prior agreement to and compensation arrangements for the sample shall be obtained before delivery of the sample container.

    b. Deliver the sample container to the dairy or resident at least a week before the desired sample collection date.

    c. Personnel obtaining the sample should be instructed on minimum sample volume, storage and date/ time recording requirements.

    d. When the sample is picked up, place the milk sample in the cooler, if necessary, for transport back to the KDHE Radiochemistry laboratory.

6. Record the time, date, and sample collection location on the outside of the wide mouth sampling container. Record sample collection information on the sample Collection/custody form, RCP/ERS-012-FORM 1.

7. Transport the samples with the sample collection form to the DHEL Radiochemistry Laboratory. Transfer sample custody to the laboratory personnel using the sample Collection/custody form.

8. Abide by any oral or written instructions given by property owners when collecting samples on private property.

9. Deviations from the procedure are to be documented.

G. Milk Sample locations

Refer to the *Wolf Creek Generating Station Environmental Radiation Surveillance Program* for the current State fiscal year. A detailed highway map of Coffey County is maintained and is available for use during milk sample collection. Historically indicator locations have usually not been available in Coffey County. This is due in part to a lack of participation by dairy animal owners. The only sample locations consistently available have been $\geq$ 10 miles from WCGS. This prompted a change from monthly sampling to sampling on a quarterly frequency.

1. WCM-R-1Lindsey Dairy, Lebo, KS *CONTROL*
   T-19-S, R-13-E, Section 23, Lincoln Twp.

   Samples are collected at the Lindsey Dairy, (761 25th Rd. NW, Lebo, KS, 66856), near the intersection of 25th Road and Homestead Road.

H. Forms

1. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form.

Terrestrial Vegetation Sample Collection: Ingestion Pathway

A. Purpose

The purpose of this procedure is to outline the surveillance activities for determining the concentrations of terrestrial vegetation radioactivity in the environment surrounding the Wolf Creek nuclear-powered generating station (WCGS).

B. Applicability

The activities in this procedure are done by Kansas Department of Health and Environment staff. No specific personnel qualifications are associated with this section.

C. General Description

Terrestrial vegetation samples should include but not be limited to: Soybeans (raw or processed), corn (food and silage), wheat (food or silage), sorghum (animal feed), fruits (food), broad leaf vegetables, common pasturage plants and tuberous/root food products. Samples should be collected at the time of harvest of principal produce grown A.) near the point having the highest χ/Q (sectors A, G, H or R), or B.) from any area where liquid plant wastes have been discharged (broadly interpreted to include crops irrigated with Neosho River water from locations downstream of the Neosho River-Wolf Creek confluence in sectors J and H), or C.) of vegetables at a private garden or farm in the immediate area of the plant.

D. Sampling Frequency

1. Pasturage trending samples will be collected annually from each location listed in section (H.) of this procedure.

2. Garden trending samples will be collected at least annually from each trending location listed in section (G). of this procedure.

3. Random samples will be collected from locations as outlined in that year's ERS Program plan. The sample collection effort should be distributed over the year to allow for a variety of samples in different growing seasons. These locations should be concentrated in, but not restricted to, the primary downwind sectors (P-C and G-K) and within the 10-mile EPZ or from any area where liquid plant wastes have been discharged (broadly interpreted to include crops irrigated with Neosho River water from locations downstream of the Neosho River-Wolf Creek confluence in sectors J and H.

E. Special Precautions

1. Insect pests such as ticks and chiggers may be present during sampling. Use of an insect repellant containing DEET is highly recommended.

2. Use of a sun screen is highly recommended. Consideration may be given to collecting samples before 1000 or after 1400 to minimize the intensity of exposure to the sun.

3. Be aware of livestock and pets in the sampling areas.

F. Equipment Requirements

Equipment necessary for terrestrial vegetation sample collection includes:

1. Shears.

2. Ziplock bags ($\geq$ 3.8 ℓ).

3. An indelible marker.

4. Area template or tape measure.

   Area templates available:

Diameter, m	Area, m^2
0.20	0.03
0.31	0.07
0.38	0.11
0.48	0.18

5. Precision spring scale.

6. Portable GPS Unit.

7. A notebook.

G. Procedure

1. Sampling is normally done in gardens or pastures. Samples obtained from gardens are analyzed on a per kg basis. Samples obtained from pastures are obtained primarily to identify airborne deposition, and the area of collection needs to be estimated.

2. Find a sample collection area approximately 100 m^2 in area, away from buildings and trees, that has not been recently mown or cultivated.

3. Site location logging:
   a. For trending locations, locate the sample site using the GPS unit. The site shall be within 50 meters (164 ft.) of the historical location. Log the GPS coordinates.

Note: Garden vegetable locations can vary from one fiscal year to the next. These locations are based on WCNOC's Radiological Environmental Monitoring Program (REMP) census results. Refer to the current FY REMP procedures for these locations.

   b. For random locations, enter a waypoint in the GPS memory. Note the waypoint number and set the waypoint to averaging while collecting the sample. Record the GPS coordinates after the sample is collected. For greater accuracy, allow the unit to average for at least three minutes.

4. Collection: The sample collected is placed in the ziplock bag.

Note:
A transfer container may be used for initial collection to simplify trimming, sorting and cleaning the sample. A transfer container is also easier to use on windy days.

   a. Using the shears, randomly collect samples within the chosen area. Vegetation is collected until a total sample mass of at least 1000 grams has been collected.

Note:
For all vegetation, a minimum of 200 grams of processed mass is required (dried and powdered) for analysis. Depending upon moisture content, this may correspond to as much as 2,000 grams of raw sample.

   b. Pasturage samples should be cut down to within one centimeter of the surface.

   c. Bulky samples, (tall grasses, large leaves or stalks), should be cut into smaller pieces.

5. Area templates are available ranging from 0.03 to 0.18 m^2 to aid in estimating

the surface area of collection.

6. If collecting fruit, roots (tubers), processed grains or silage; estimation of the area is not required.

7. Remove any debris, such as sticks and rocks, and mix the sample. Minimum sample weight must still be met after cleaning. Samples that are to be shared will be split *after* the sample has been cleaned and mixed.

8. Clean the sampling tools after each sample collection.

9. Record the time, date, and sample collection location on the outside of the sample collection container. Record sample collection information on the Laboratory Collection/custody Sheet (RCP/ERS -012-Form1). Locations will be identified with the following ID formats:

Trending Locations:

WCFV -(sector)-(historical reference #)-(bearing from WCNOC ref.)-X.X (miles from WCNOC ref.)

(Ex.: WCFV-A-1-000-1.7)

Random Samples:

WCRFV-##(sequential number)-(sector)-(bearing from WCNOC ref.)-X.X (miles from WCNOC ref.)

(Ex: . WCRFV-01-R-330-4.5)

10. Transport the samples with the sample collection form to the DHEL Radiochemistry Laboratory. Transfer sample custody to the laboratory personnel using the Laboratory Collection/custody Sheet (RCP/ERS -012-Form1).

11. Abide by any oral or written instructions given by the property owners when collecting samples on private property.

12. Deviations from the procedure are to be documented.

H. Terrestrial Vegetation Sample Locations

Refer to the *Wolf Creek Generating Station Environmental Radiation Surveillance Program* for the current State fiscal year. A detailed highway map of Coffey County and the Current Rural Directory is available for use during terrestrial vegetation sample collection. Note that soil samples may be obtained concurrently with pasturage samples.

Garden vegetable locations can vary from one fiscal year to the next. These locations are based on WCNOC's Radiological Environmental Monitoring Program (REMP) census

results. Refer to the current FY REMP procedures for these locations. Garden vegetable trending samples are usually split with WCNOC. Below is a list of Terrestrial Vegetation trending sample locations.

1. WCFV A-1-005-2.5 (A.0.1) North of WCGS
   R16E, T20S, Section 31 E. Ottumwa Twp., **N38 16 28.4 W95 41 04.9** (WGS 84)

   Sample location is approximately 2.5 miles north of WCGS, on WCNOC property. A State of Kansas and WCNOC TLD is also near this site. The alternate sampling site is near the air sampler at Sharpe.

2. WCFV E-1-087-5.8 (E.2.1) Scott Valley Church *CONTROL*
   R17E, T21S, Section 6, Star Twp., **N38 14 34 - W95 34 55** (WGS 84)

   The property is owned by Shilling's (heirs). The pastor is Rev. Ken Davidson. The caretaker is Maxine Payer, 2365 13th Road, southeast Westphalia.

3. WCFV H-1-157-3.1 (H.1.3)Near Salava's pond
   R16E, T21S, Section 28, Star Twp., **N38 11 53.0 W95 40 02.0** (WGS 84)

   Sample location is approximately three miles southeast of WCGS, across the road from the Logan cemetery. The property is owned by James H. Salava, 1876 10th Road, southeast Burlington. This location is also a historical surface water sampling site. An alternate site is near the air sampler, located east of the Coffey County Lake (CCL) Dam.

4. WCFV P-1-289-1.6 (P.0.2) CCL public access fishing area
   N38 14 46.9 W95 42 57.4 (WGS 84)

   Sample location is near the makeup discharge structure (MUDS), approximately two miles east of the WCGS. Property is owned by WCNOC, and is a split sample location. Shoreline sediments and aquatic vegetation are also collected at this site. A WCNOC and State of Kansas TLD are also at this site.

5. WCFV R-1-330-2.9 (R.1.2)CCL Environmental Education Area (EEA)
   N38 16 32.7 W95 42 57.2 (WGS 84)

   Sample location is approximately 3.5 miles north northeast of the plant, north of the EOF. Property is owned by WCNOC, and is a split sample location. Shoreline sediments and aquatic vegetation are also collected at, or near, this site. A WCNOC and State of Kansas TLD are also at this site.

I. Forms

1. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form.

Animal Sample Collection: Ingestion Pathway

A. Purpose

The purpose of this procedure is to outline the surveillance activities for determining the concentrations of animal radioactivity in the environment surrounding the Wolf Creek nuclear-powered generating station (WCGS).

B. Applicability

The activities in this procedure are done by Kansas Department of Health and Environment staff. No specific personnel qualifications are associated with this section.

C. General Description

Animal sample collection includes fish, invertebrates, game, and domestic meat producers. A sample usually consists of edible meat portions, but inedible fish portions are analyzed periodically. A gamma isotopic analysis is done on each sample collected. A tritium in tissue analysis is done on one type of fish from each location.

Fish collection is done semiannually. Collection from the Wolf Creek Lake and below John Redmond Reservoir is usually done by WCNOC personnel with KDHE personnel observing from the shore. Fish collection by WCNOC is by netting or electro-shocking. KDHE personnel have periodically assisted WCNOC personnel in the collection of fish by boat. Invertebrates are usually not available in large enough numbers to warrant sample collection. Historically, the only invertebrates collected have been crayfishes.

Game animal sampling is usually limited to the collection of edible meat portions from road-killed deer. This has been discontinued by WCNOC and KDHE, but the sample collection permit still allows for the taking of game. Domestic meat samples are obtained on an as needed basis.

D. Special precautions during sample collection

1. Rubber gloves should be worn when handling raw meat, especially if sampling road-killed deer. If gloves are not worn, then throughly wash hands with antibacterial soap and water or sanitizer afterwards.

2. Fish collection is done by WCNOC using a boat. Observe all boating safety regulations if assisting WCNOC, especially the wearing of proper floatation devices. Falling overboard is a hazard during net pulling operations.

3. Severe shock is possible during fish electroshock operations if proper safety precautions are not taken. KDHE personnel may assist only if under the direct supervision of a trained WCNOC electroshock apparatus operator.

E. Equipment Requirements

Equipment necessary for animal collection includes:

1. Kansas Scientific, Education, or Exhibition Wildlife Permit.

2. Portable GPS Unit.

3. A sharp knife for cleaning animals.

4. Ziplock bags ($\geq$ 3.8 ℓ).

5. Orange reflective vest and hat (if hunting).

6. Floatation vests (if in a boat).

7. Cleaning board for fish-optional.

8. Fishing pole, bait, net, and seine-optional.

9. Hip waders-optional.

10. A shotgun and shells with steel shot-optional.

F. Procedure

1. Sample collection is to be done under the guidelines and restrictions of the *Scientific, Education, or Exhibition Wildlife Permit* issued by Kansas Wildlife and Parks.

2. Hunting with a firearm, under the *Scientific, Education, or Exhibition Wildlife Permit,* requires successful completion of a Certified Hunter Safety Course. High-powered rifles are prohibited on WCNOC property. Game collection on private property requires owner permission. Abide by any oral or written instructions given by the property owners when collecting game on private property.

3. Only edible portions of game and domestic meat samples are to be submitted to the KDHE Radiochemistry Laboratory unless otherwise specified. Both edible and inedible fish portions may be submitted to the DHEL

Radiochemistry Laboratory. The minimum sample mass required is 500 grams.

4. Record the time, date, and sample collection location on the outside of the sample collection container. Record sample collection information on the Laboratory Collection/custody Sheet (RCP/ERS -012-Form1). Locations will be identified with the following ID formats:

WC(F)(DM)(GM)*-##(sequential number)-(sector)-(bearing from WCNOC)-X.X (miles from WCNOC)

(Ex: WCF-01-R-330-4.5)

**F = fish, DM = domestic meat, GM = game*

5. Transport the samples with the sample collection form to the KDHE Radiochemistry Laboratory. Transfer sample custody to the laboratory personnel using the Laboratory Collection/custody Sheet (RCP/ERS -012-Form1).

6. Deviations from the procedure are to be documented.

G. Animal Sample Locations

Refer to the *Wolf Creek Generating Station Environmental Radiation Surveillance Program* for the current State fiscal year. Sample collection locations are highly variable. A detailed highway map of Coffey County is maintained and is available for use during animal sample collection. Samples split with WCNOC include fish collected below John Redmond Reservoir and on WCNOC property. Meat portions from road-killed deer are usually collected by WCNOC personnel and split with KDHE for analysis.

1. WCF N-1 (N.1.2) John Redmond Reservoir *CONTROL*
R15E, T21S, Section 4, N38 14 08.2 W95 45 41.7 (WGS 84)

   Fish are collected below the spillway on the Neosho River. The site is on federal property. Samples are split with WCNOC. Surface water, sediment, and aquatic vegetation samples are also collected near this site.

2. WCF Q-1 (Q.0.1) Coffey County Lake (CCL) Discharge Cove
N38 14 33.0 W95 41 36.0 (WGS 84)

   The site is owned by WCNOC. Fish are collected close to the WCGS discharge point. Surface water, sediment, and aquatic vegetation sample collection is also done near this site. A State of Kansas and WCNOC TLD is also near this site.

H. Forms

1. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form.

Miscellaneous Sample Collection

A. Purpose

The purpose of this procedure is to outline additional surveillance activities for determining the concentrations of radioactivity in the environment of the State of Kansas.

B. Applicability

The activities in this procedure are done by Kansas Department of Health and Environment staff. No specific personnel qualifications are associated with this section. Some samples may require radiological evaluation in the field; personnel evaluating these samples should be familiar with radiation monitoring equipment.

C. General Description

Beyond the WCGS environmental radiation surveillance activities, additional groundwater and surface water sample collection around the State of Kansas is done by the Bureau of Water and the Bureau of Environmental Field Services. These sampling procedures are not the responsibility of the Radiation Control Program and are not included in this document.

Routine milk sample collection is done from two milk sheds in the State. The samples are collected as needed from local retail outlets in Topeka by Radiation Control Program Environmental Radiation and Emergency Preparedness Section. Gamma isotopic and low-level ^{131}I analyses are done on each sample collected. An annual strontium analysis is also done.

Sample collection procedures for use during a nuclear emergency around the WCGS have also been developed by Radiation Control Program Environmental Radiation and Emergency Preparedness Section staff:

1. Joint Radiological Monitoring Team Procedures, No. DHE/WC31, and;

2. Procedures for Ingestion Pathway Sample Collection, No. DHE/WC34.

During a nuclear emergency, procedures DHE/WC31 and WC34 supersede any RCP/ERS series sample collection procedure.

Procedures for the collection of public drinking water samples, test well water samples, radon in water samples, and hospital effluent samples have been developed by the Radiochemistry Section of the Kansas Health and Environmental Laboratory, Kansas

Department of Health and Environment. These procedures may be found in the Radiochemistry Laboratory Quality Assurance Plan and Standard Operating Procedures manual.

Samples may also be collected during licensee inspections conducted by the Radiation Control Program Radioactive Materials and X-ray Section. Samples collected are usually wipes, but other types of samples may also be collected. Additional types of samples collected may include swabs, liquids, and soil. Sample collection procedures are highly variable and are dependent upon the type of facility being inspected. Sample collection is usually described in the facility inspection report. Personnel performing surveys and sample collection in these facilities will adhere to all applicable postings and dosimetric requirements. Analyses done on samples collected during inspections are varied, but a gamma isotopic analysis is usually done on all samples collected.

Radiological material investigations are conducted by both sections of the Radiation Control Program. Sample collection during these investigations may involve a wide range of materials. These materials may include wipes, liquids (water and solvents), crushed rock, soil, pipe scale, sludge, fixtures, carpet, metal filings, vacuum cleaner contents, and debris. Many samples collected during investigations may contain Technologically Enhanced Naturally Occurring Radioactive Material (TENORM). This material contains radioisotopes of the uranium and thorium decay series, most notably ^{226}Ra. Sample collection procedures are highly variable during an investigation and are usually described in the investigation report. Analyses done on samples collected during investigations are varied, but a gamma isotopic analysis is usually done on all samples collected.

D. Equipment

Equipment necessary for miscellaneous sample collection is variable and job specific.

E. Procedure

1. Routine milk collection is done as needed from two milk sheds in the State. Payment is out of pocket and submission of the appropriate reimbursement form to the business office is required for compensation.

2. Sample collection methods used during inspections and investigations will be documented. Specific direction may be given by the Chief of the Radiation Control Program.
3. Abide by any oral or written instructions given by the property owners when collecting game on private property.

4. Record the time, date, and sample collection location on the outside of the sample collection container. Record sample collection information on the sample Collection/custody form, RCP/ERS-012-FORM 1.

5. Transport the samples with the sample collection form to the DHEL Radiochemistry Laboratory. Transfer sample custody to the laboratory personnel using the sample Collection/custody form.

F. Sample Locations

Sample locations during inspections or investigations are highly variable and are found by referencing the appropriate inspection or investigation report.

G. Forms

1. RCP/ERS-012-FORM 1, Kansas Department of Health and Environment Radiochemistry Laboratory Collection/custody form.

Low Volume Air Sampler Maintenance and Calibration

A. Purpose

The purpose of this procedure is to specify maintenance and calibration procedures for air sampling devices used in determining the concentrations of atmospheric radioactivity in the environment surrounding the Wolf Creek nuclear-powered generating station (WCNGS).

B. Applicability

The activities in this procedure are normally done by the ERS/EP Environmental Technician or the ERS/EP Radiological Control Inspector. (See KDHE personnel technical qualification standards for ET III and RCI.)

C. General Description

Low-volume regulated air samplers (30 LPM) are used in the KDHE Environmental Radiation Surveillance Program for continuous low-volume air sampling. The air sample consists of a particulate filter and a charcoal cartridge assembled in a sampling head. Air samplers are calibrated annually. Filters are cleaned or replaced at every calibration period or after each field cycle. Gaskets and O-rings are replaced as needed. Graphite vanes are replaced after approximately 9,000 hours of operation or after 3/16 inch (6 mm) of wear is noted. Some air samplers use bypass air regulators. These regulators should be rebuilt after approximately 18,000 hours of operation.

D. Equipment

Equipment necessary for air sampler calibration and maintenance includes:

1. Gaskets, filters, O-rings, carbon vanes, regulator rebuild kits.

2. F&J model D-812 flow calibrator.

3. Sample collection head with flow meter adapter assembled with the proper sample media and the flow meter adaptor.

4. A small and regular sized flat bladed screwdriver.

5. Socket and ratchet set (3/8 inch and 7/16 inch).

6. Air sampler calibration data sheet, RCP/ERS-013 FORM 1 or RCP/ERS-013 FORM 1EL, Electronic Air sampler calibration data sheet.

E. Maintenance Procedure

There are currently four different types of low-volume regulated air samplers used in the KDHE ERS program. All pumps use a GAST type electric motor, and use similar filters, gaskets, 0-rings, and carbon vanes. Two pumps in service are the RADECO /SAIC Model AVS-28A. These pumps do not use a bypass regulator for flow control. These pumps use a direct flow-through regulator. The other pumps in use are the Eberline Model RAS-1 and the F&J model LV-1D, which use a bypass air regulator for flow control. Appropriate operating and maintenance manuals should be referred to when performing the procedure below.

1. Clean the outside of the pump with a damp cloth. Vacuum or blow out dust from internal or inaccessible areas.

2. Visually inspect the integrity of pump components. Replace PVC hoses as needed.

3. Unscrew and remove filter assembly jars and filters (if used). Filters may be replaced or washed in warm soapy water. The jars may also be washed in warm soapy water.

4. Some filters are located internally and are removed via access plugs. Remove these plugs and clean or replace the filters and O-rings upon reassembly of the pump.

5. Remove the pump end housing(s). Some pumps have double housings. Replace vanes if chipped, cracked, or if 3/16" (6 mm) or greater wear is noted. *Note orientation of vanes before removal.* If a vane is put in backwards, it may break when the pump is energized. A new vane is approximately 35 mm or $1\ ^{3}/_{8}$" in length.

6. Inspect internal pump components and surfaces for signs of cracking, pitting, or scouring. A scoured surface is an indication of a worn bearing. Vacuum around the pump rotor.

7. Reassemble the pump, replacing any gaskets as necessary. Tighten the bolts sequentially and do not over torque. A good seal is needed for proper pump operation. Calibrate the pump according to the following procedure.

F. Calibration Procedure

1. Warm up and zero the flow calibrator:

   a. Plug in the power supply. Turn on the switch.

b. Allow the flow calibrator to warm up for at least 10 minutes. Connect the hose with the in-line filter to the inlet side of the unit.
c. Attach the calibration collection head assembly to the outlet side of the unit.
d. The unit will self zero and self check. With no flow the unit should read 0.00 cfm.

2. Turn on the pump and leak check the unit by placing your hand over the inlet. The flow rate of the pump should drop to < 10 LPM. If the flow rate does not drop, then there is an air leak in the unit. If the unit still does not leak check properly, then the calibration cannot be done and the unit will be removed from service for further maintenance. Turn off the pump.

3. Attach the calibration sample collection head to the pump.

4. Check and record the barometric pressure with the pump **OFF** by selecting "*in. Hg*" on the flow calibrator.

5. The air flow adjustment varies with the type of pump.

Note:
The flow rate should be read from the bottom of the rotometer indicator ball.

6. Bypass regulator pumps:
   a. The Eberline pumps use an adjustment screw is found on the side of the regulator. A flathead screwdriver is required. The F&J pumps use an adjustment knob found on the top of the regulator.
   b. Turn on the pump.
   c. Refer to the calibration log sheet. Adjust the flow from 20 LPM to 45 SLPM, in 5 SLPM increments, using the flow calibrator reading. (*Column (1)*)
   d. Record the corresponding rotometer readings, in LPM, on the air sampler calibration data sheet (*Column (3)*).
   e. Check and record the air temperature by selecting "*degrees F*" on the flow calibrator.
   f. Determine the actual flow rates (*column (2)*) using the formula below (the electronic worksheet will do this automatically).
   g. Determine the flow corrections factors (*column (4)*) by dividing the actual flow rate by the rotometer flow rate. (*Column (2)/ Column (3)*)
   h. Calculate the average flow correction factor. If this number is **less than** 0.8, replace the rotometer and recheck the pump. If this number is **0.8 or greater**, go to step (F.6.i).
   i. Adjust the pump flow until the calibrator reads 30.0 ± 0.1 SLPM and recording the rotometer reading to the nearest ± 2.5 LPM. This is the operational flow setting.

7. Pressure regulator pumps:
   a. The SAIC air pumps are adjusted using a regulator handwheel, which is reached by removing the black cover (a flathead screw driver is needed to remove two screws).
   b. Turn on the pump.
   c. Allow the pump to run for five minutes, then check and record the air temperature by selecting "*degrees F*" on the flow calibrator.
   d. Adjust the flow rate to 30 ± 0.1 SLPM as indicated on the flow calibrator.
   e. Unlock the Rotometer adjustment screw by loosening the locking nut. (Located on top of the Rotometer).
   f. Adjust the Rotometer flow reading to 30 LPM using the adjustment screw and tighten the locking nut.
   g. Refer to the calibration log sheet. Using the regulator handwheel, adjust the pump flow rate from 20 to 45 SLPM in 5 SLPM increments as indicated by the flow calibrator. (*column (1)*)
   h. Record the Rotometer readings, in LPM, on the air sampler calibration data sheet. (*column (3)*)
   i. Determine the actual flow rates (*column (2)*) using the formula below (the electronic worksheet will do this automatically).
   j. Determine the flow corrections factors (*column (4)*) by dividing the actual flow rate by the Rotometer flow rate. (*Column (2)/ Column (3)*).
   k. Calculate the average flow correction factor (CF). *The Electronic RCP/ERS -013 FORM 1EL will perform this calculation as the form is filled in.* If this number is **less than** 0.9 or **greater than 1.1**, remove the pump from service for repair. If this number is **0.9 to 1.1**, go to step (F.7.l).
   l. Reset the regulator to 30 ± 0.1 SLPM as indicated on the flow calibrator.
   m. Allow the pump to run for 30 minutes.
   n. Check that the Rotometer reading is 30 LPM. Record 30 LPM as the Rotometer 30 ± 0.1 SLPM setting. If the Rotometer indication is > or < 30 LPM by more than the width of the ball, re perform steps (b - l). If the flow rate is still out of tolerance, remove the pump from service for repair.

8. Record the average flow CF, the 30.0 ± 0.01 SLPM Rotometer set point (LPM), date and calibration technician on the RCP/ERS -013 FORM 1 and on the calibration tag for each pump.

Calculated (Actual) Flow Formula

$$ActualFlow = SLPM \times \left[\left(\frac{^{\circ}F + 460}{530} \right) \times \left(\frac{29.92}{"Hg} \right) \right]$$

G. Forms

1. RCP/ERS-013 FORM 1, Air sampler calibration data sheet.

2. RCP/ERS-013 FORM 1EL, Electronic Air sampler calibration data sheet, H:\Radiation\ERS\Air Sampler Cal Sheet.WB3

TLD Reader Operation, Maintenance, and Calibration

A. Purpose

The purpose of this procedure is to specify operation, maintenance, and calibration procedures for the Radiation Control Program's thermoluminescent dosimetry (TLD) system as used to determine the direct radiation levels in the environment surrounding the Wolf Creek nuclear-powered generating station (WCGS).

B. Applicability

The activities in this procedure are done by Kansas Department of Health and Environment staff. Personnel must be familiar with Victoreen 2800M TLD reader operation.

C. General Description

Direct radiation monitoring is accomplished by the Radiation Control Program's thermoluminescent dosimetry (TLD) system, which consists of a Victoreen 2800M reader using Victoreen Model 2600-49 axial bulb manganese-doped calcium fluoride (CaF_2:Mn) radiation dosimeters. The dosimeters are individually calibrated to ^{137}Cs (cesium) annually and each reading is corrected for fading, self irradiation, and any dose received while in transit.

Thirty-one locations around the WCGS are monitored by KDHE, including three control locations greater than ten miles from WCGS. Three bulb dosimeters are used per site to generate an average quarterly reading per site. The dosimeters are contained in specially constructed PVC plastic holders suspended approximately one meter above the ground. KDHE staff exchange TLDs quarterly per procedure RCP/ERS-001, *Radiation Dosimetry Exchange: Direct Radiation Pathway*. KDHE has collocated TLDS with WCNOC at fourteen sites.

D. Equipment Requirements

1. Cotton gloves.

2. Stop watch or equivalent.

3. Gamma radiation survey meter.
4. Radiation warning signs and boundary rope.

5. *Calibration in Progress* sign for entrance to calibration room.

6. Needle nose pliers.

7. TLD cap removal wrench.

8. ^{137}Cs source exposure information for TLD calibration table.

9. Magnifying glass-optional.

E. Procedure

1. TLD Exchange Preparation

   (Preparation for a TLD exchange will take approximately four hours)

   a. Do a 'reference light source' check on the TLD reader. Anneal the TLD bulbs by running them through a read cycle in the reader. Note any unusual glow curves and physically inspect the bulbs and TL elements for damage or indication of deterioration.

   b. Expose calibration TLDs to a nominal exposure of 21.6 mR. These TLDs may be evaluated 12 to 24 hours after exposure to verify energy calibration factors. These TLDs may be read with the incoming TLDs.

   c. Assemble paperwork for TLD exchange

   d. Inspect physical condition of PVC dosimeter holders. Replace labels as necessary.

   e. Three TLDs are assigned to each PVC holder. Place assigned TLDs in each of their respective PVC holders. Secure end caps ensuring a snug fit.

   f. Go to procedure RCP/ERS-001, *Radiation Dosimetry Exchange: Direct Radiation Pathway*.

2. TLD Reader General Operation

   a. The TLD reader should be on always. If it is off, then turn on and allow the unit to stabilize for at least four hours.

   b. A white cotton glove should be worn when handling TLD bulbs. To warm the unit up, run at least five TLDs through the read cycle before doing the *Reference Light Check*.

   c. Perform a *Reference Light Check* before operation, and every hour

thereafter. If the unit is idle, perform the Reference light check at least once a week.

d. The bulb current should be 6.00 ± 0.02 A when in the read cycle with a bulb in the read head, otherwise 0.00 A should be displayed. Current instrument settings are: PMT HV = 900V, ROI = CH 47 to 149, CYCLE TIME = 20 s, and TIME CONSTANT = 10 × 0.1 s.

e. The dark current is a background reading obtained after the read cycle when no bulb is in the read head. It is an indication of electronic noise/stability of the power supply.

f. The TLD reader display output is in Coulombs. Each TLD is read twice. The first reading is the gross reading. The second reading is the background reading. The TLD is not read a second time until after the bulb has cooled at least 5 minutes. The second reading is subtracted from the first reading. The net reading, in Coulombs, is then divided by the sensitivity factor (Coulombs/mR) to determine the exposure, in mR.

g. Detailed operating procedures are found in the Victoreen Instruction Manual: *Thermoluminescence Dosimeter (TLD) Reader Model 2800M*. A flow chart of the TLD reader operation is found in Graph 1.0 with the flowchart description given in Table 1.0.

3. TLD Calibration

a. The TLDs are calibrated using the Radiation Control Program “small” ^{137}Cs source, manufactured by Nuclear Chicago Corp. (Model RR-137) and purchased in the early sixties (nominal output was 100 ± 10% mCi). The source output was initially determined using an NBS (NIST) traceable, calibrated condenser R-chamber. Periodic verifications using a calibrated condenser R-chamber have been made since. A wooden table assembly attaches to the source shield, allowing for the calibration of up to 56 TLDs at a source-to-detector distance of 25.5 inches. This calibration assembly is stored in the Radiation Control Program’s Calibration Room.

b. Each TLD is exposed and read three times, using a target exposure of 21.6 mR each time. This exposure is equivalent to the TLDs receiving 10 µR/h over a 90-day period. The average sensitivity factor is then calculated.

c. Properly post immediate vicinity of the source as a *Radiation Area* and use boundary rope to limit access. The door to the calibration lab is locked and posted with a *Calibration in Progress* sign during calibration operations.

F. FORMS

1. RCP/ERS-014-FORM 1, TLD data collection manual worksheet.

2. RCP/ERS-014-FORM 2, TLD reader reference light check form.

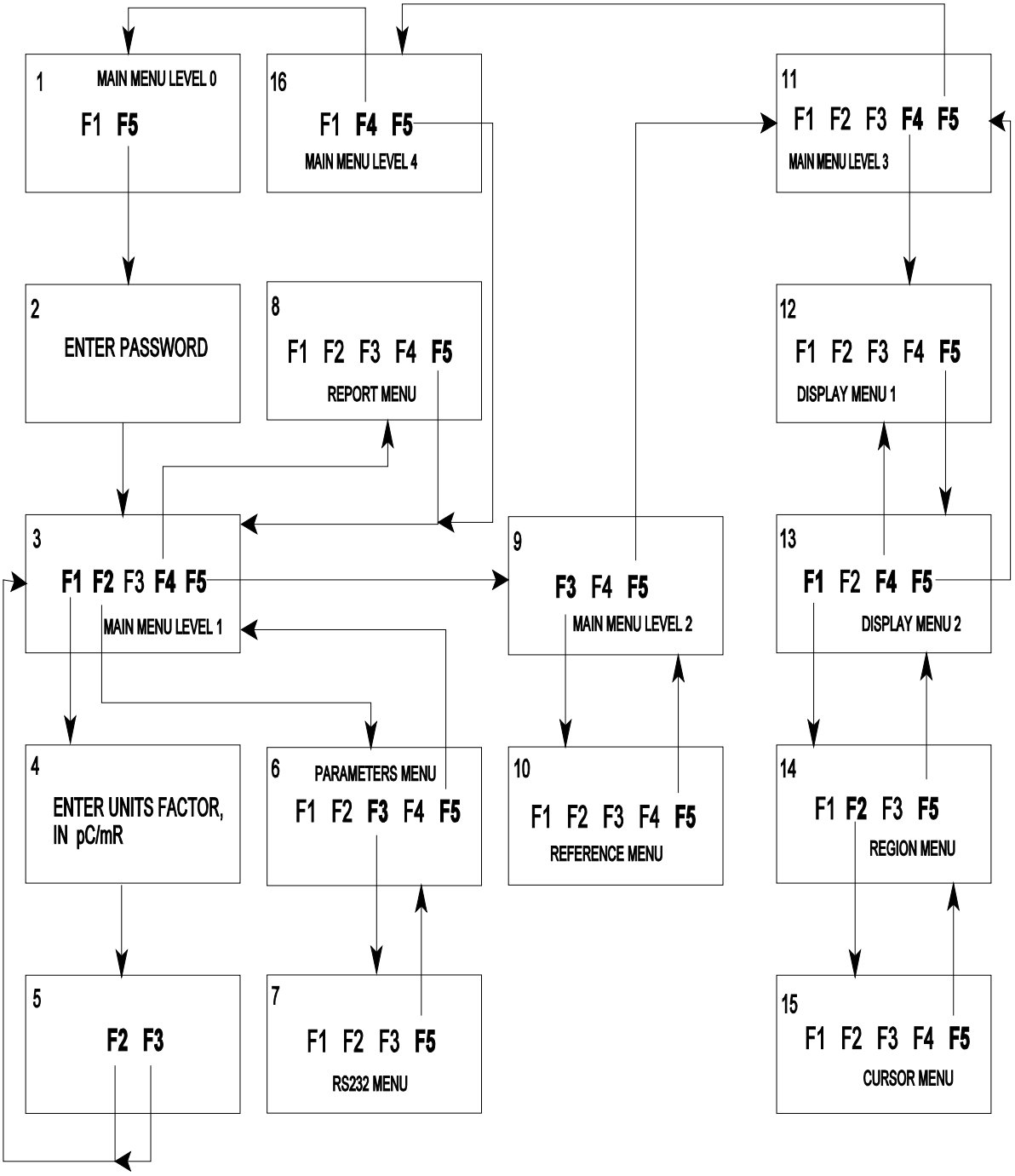

Figure 1.0 TLD reader flowchart.

Table 1.0 TLD reader flowchart description.

Menu number	Function Key					Screen information
	F1	***F2***	***F3***	***F4***	***F5***	
1	RUN				ENTER PASSWORD GOTO Menu 2	*Main menu level 0* Time/Date/0.00 A/Setup functions are locked out/BULB MODE/MAIN MENU
2	**-1234** Press ***ENT*** GOTO Menu 3					Date/Enter your password: __ /BULB MODE
3	SELECT R or Gy/SELECT COULOMBS IF SELECT R or Gy GOTO Menu 4	SYSTEM PARAMETERS GOTO Menu 6	ID NUMBER ID NUMBER __ Press ***ENT***	REPORT GOTO Menu 8	MORE GOTO Menu 9	*Main menu level 1* Initial: Time/Date/0.00 A/2800M setup functions are accessible/BULB MODE/MAIN MENU If not initial startup, may see display readout in Coulombs: xxx __C xxx __C/Response function, Y = A, X = time (5 SEC MARKERS)/ID NUMBER Units displayed may also be __R or __Gy. *Note: Display normally toggled to SELECT COULOMBS, F1 will show SELECT R or Gy.*
4	**Current calibration SF_{avg} in pC/mR** Press ***ENT***					Date/UNITS FACTOR X pC/mR *(1 is the default value)*/FACTOR FOR GRAYS IS .00965 Gy/R/UNITS FACTOR __ pC/mR /BULB MODE
5		ROENTGENS GOTO Menu 3		GRAYS GOTO Menu 3		Date/UNITS FACTOR X pC/mR *(1 is the default value)*/FACTOR FOR GRAYS IS .00965 Gy *Note: F2 or F4 returns to Screen 3, F1 will now read SELECT COULOMBS and the display will be in _R or _Gy. To return the display to _C, press F1.*
6	SET TIME TIME __:__ Press ***ENT***	SET DATE __/__/__ Press ***ENT***	RS232 PARAMETERS GOTO Menu 7	TONE OFF/TONE ON	EXIT PARAMETERS GOTO Menu 3	*Parameters menu* Time/Date/0.00 A/BULB MODE/PARAMETERS MENU

Table 1.0, cont. TLD reader flowchart description.

7	BAUD RATE F1 ↓ F2 ↑ F3 → F4 ← F5 ACCEPT MENU ITEM	PARITY F1 ↓ F2 ↑ F5 ACCEPT MENU ITEM	STOP BITS F1 ↓ F2 ↑ F3 → F4 ← F5 ACCEPT MENU ITEM		EXIT GOTO Menu 6	*RS232 menu* Time/Date/0.00 A/BAUD Rate XXXX/WORD LENGTH X BITS X STOP BIT/PARITY __ /ECHO __/BULB MODE/RS232 MENU
8	START REPORT	PARAMETERS\FULL \GRAPHIC\SHORT REPORT	AUTO\MANUAL REPORT	RS232/PRINTER	EXIT GOTO Menu 3	*Report menu* Time/Date/0.00 A/__ REPORT TO __/BULB MODE/REPORT MENU
9			REFERENCE LIGHT GOTO Menu 10	CYCLE TIME CYCLE TIME __ SECOND Press ***ENT*** Currently set to 20 seconds	MORE GOTO Menu 11	*Main menu level 2* Time/Date/0.00 A/BULB MODE/MAIN MENU If cycle time set: CYCLE TIME X SECOND
10	RUN REFERENCE	SELECT HIGH V HIGH V __ V Press ***ENT*** Currently set to 900 V	HIGH V ↑	HIGH V ↓	EXIT GOTO Menu 9	*Reference menu* Time/Date/PROGRAMMED HIGH V __ V/REFERENCE MODE/ SELECT LIGHT SOURCE/REFERENCE MENU
11	RUN	SCALE DATA	TIME CONSTANT TIME CONSTANT __ × 0.1 SEC Press ***ENT*** Currently set at 10 × 0.1 SEC	DISPLAY DATA GOTO Menu 12	MORE GOTO Menu 16	*Main menu level 3* Time/Date/0.00 A/ BULB MODE/MAIN MENU After RUN or DISPLAY will see display readout in Coulombs: xxx __C xxx __C/Response function, Y = A, X = time (5 SEC MARKERS)/ID NUMBER Units displayed may also be __R or __Gy
12	SCALE × 10	SCALE /10	SCALE × 3	LOG DISPLAY/LINEAR DISPLAY	MORE GOTO Menu 13	*Display menu level 1* Time/Date/0.00 A/xxx __C xxx __C/Response function, Y = A, X = time (5 SEC MARKERS)/ID NUMBER/BULB MODE/DISPLAY MENU Units displayed may also be __R or __Gy

Table 1.0, cont. TLD reader flowchart description.

13	REGION OF INTEREST GOTO Menu 14	TOTAL AREA/REGION AREA		MORE GOTO Menu 12	EXIT GOTO Menu 11	*Display menu level 2* Time/Date/0.00 A/xxx __C xxx __C/Response function, Y = A, X = time (5 SEC MARKERS)/ID NUMBER/BULB MODE/DISPLAY MENU Units displayed may also be __R or __Gy
14	REGION 1/REGION 2	DEFINE REGION GOTO Menu 15	ZERO REGION		EXIT GOTO Menu 13	*Region menu* Time/Date/0.00 A/xxx __C xxx __C/Response function, Y = A, X = time (5 SEC MARKERS)/ID NUMBER/BULB MODE/REGION MENU If exiting from Menu 15 will also see cursor position channel numbers Units displayed may also be __R or __Gy
15	CURSOR A ←	CURSOR A →	CURSOR B ←	CURSOR B →	EXIT GOTO Menu 14	*Cursor menu* TIME/DATE/PRESS +/- FOR FINE (COARSE) CURSOR/0.00 A/xxx __C xxx __C/CURSOR A __ (channel number)/CURSOR B (channel number)/Response function, Y = A, X = time (5 SEC MARKERS)/ID NUMBER/BULB MODE/CURSOR MENU Units displayed may also be __R or __Gy
16	SELECT PASSWORD Enter your password __ Press ***ENT*** Select new password ___ Press ***ENT*** Do you really want to change password? F2 = YES, F4 = NO			EXIT SETUP GOTO MENU 1	MORE GOTO Menu 3	*Main menu 4th level* TIME/DATE/0.00 A/xxx __C xxx __C/CURSOR A __ (channel number)/CURSOR B (channel number)/Response function, Y = A, X = time (5 SEC MARKERS)/ID NUMBER/BULB MODE/MAIN MENU Units displayed may also be __R or __Gy

Portable GPS Operation

A. Purpose

This Standard Operating Procedure (SOP) will outline the functionality of the Garmin GPS III+ for the Radiation Control Program (RCP). The Garmin GPS III+ is a handheld navigation tool to be used primarily to assist field staff to find a predetermined location (sample point/area), to determine spatial relationships, and to mark sample locations for computer database entry and mapping.

B. Applicability

1. For detailed GIS mapping use refer to Division of Environment **SOP No. BWM-007** for GIS applicability, data and accuracy requirements.
2. This procedure applies to the Garmin GPS III+ units only. The elements of this SOP will be applicable to all Garmin GPS III+ deployed within the Radiation Control Program.
3. This SOP will describe the necessary training for field operation, maintenance, and troubleshooting of the Garmin GPS III+.

C. Minimal Technical Qualifications and Training of Operator

1. The operator shall be familiar with all applicable procedures described in the operator's manual.
2. The operator shall be familiar with Division of Environment **SOP No. BWM-007** and this SOP.
3. The GPS Administrator verifies who is ready to operate the unit. The GPS Administrator will be designated by the section chief.

D. Operational Instructions

1. Some steps in this procedure are in **bold** type. This is to allow the user to quickly find the steps required to efficiently operate the unit in the field.
2. The operator shall inspect the GPS unit and related equipment for proper, safe operation before going to the field. Any problems with the unit detected by the operator shall be reported to the GPS Administrator. Refer to the troubleshooting section for additional information.
3. The Garmin web site (http://www.garmin.com/support) should be visited periodically by the GPS Administrator to check for the availability of product updates for the GPS III+ operating software and/or the *MapSource*® software.
4. Unless permission has been given beforehand, only the GPS Administrator may delete waypoints or change settings on the unit.
5. Operators should be mindful of the quality of all data to be submitted for database and mapping purposes, and should keep appropriate documentation to validate their data sets.

E. Initial Setup

1. Allow the unit approximately five minutes to **AutoLocate** itself under the following circumstances.
   a. The first time it is used out of the box.
   b. After it has been moved with the power off over 500 miles from last usage point.

c. If it's memory has been cleared and all internally stored data has been lost.
d. After a software update.

2. The following procedure describes how to change the settings that need to be changed by the GPS Administrator before the unit is given out for field data collection.
   a. From any screen press the MENU button twice to bring up the **Main Menu** screen.
   b. Highlight **Setup** and press the ENTER/MARK button.
   c. Using the rocker keypad select the **Time** tab at the top of the screen.
   d. Select the **Time Format** field and press the ENTER button.
   e. Highlight **Local 24hr** and press the ENTER button.
   f. Select local time zone and press ENTER.
   g. Adjust as needed to correct for the local time zone. Central time is usually five hours behind UTC. (Six hours during daylight savings.) Press ENTER when done. *Note: This setting should only be in whole hours. The GPS gets its time stamp from the satellites. If the time on the GPS differs from your watch after satellite location, adjust your watch.*
   h. Select the **Time** tab at the top of the screen and move to the **Position** screen.
   i. Select the **Position Format** field and press the ENTER button.
   j. Highlight **hddd.ddddd**°and press the ENTER button.
   k. All remaining user settings leave at default values.
   l. Press the QUIT button once to return to the **Main Menu** screen and twice to return to the screen you started out at.
   m. The GPS Administrator will load any maps, routes or pre-selected waypoints as required for the project.

F. Using the GPS III+ Unit

1. Try to give the antenna a clear and unobstructed view of the sky.
2. Turn the unit on by pressing and holding the red POWER button until the screen turns on.
3. Allow the unit approximately one minute to acquire satellite information. Do not move the unit during this process.
4. After the unit has switched from the **Satellite Status Page** to the **Map Page**, it is ready for use. If you switch back to the **Satellite Status Page**, it should read **3D Navigation** at the top of the screen.
5. The unit has six main pages that are linked together and provide content related information to the user. Pressing the PAGE key moves through the main pages in normal fashion. The QUIT key moves through the pages in reverse order.
6. Each page has a menu screen used to change fields/settings or input data. The menu screens can be accessed by pressing the MENU button. Once on one of these menu screens, pressing the MENU button again will bring up the **Main Menu** for the unit, where you can access the **Setup** screen along with other features.
7. Turn the unit off by pressing and holding the red POWER button until the screen turns off.

G. Data Collection Procedures

1. Waypoint naming convention
   a. Before the unit is taken out in the field a suitable naming convention will be developed between the GPS Administrator and the field operator.
   b. The preferred method is to set a "dummy" waypoint at a predetermined three digit number, such as 500, before it is handed out.
   c. After this "dummy" waypoint is set, each new waypoint collected out in the field will be automatically numbered consecutively by the unit starting with the next number after the dummy.
   d. If this method is used you may skip steps G.2.b.(1)- (4), because you will not need to alter the name of the waypoint.
   e. A log sheet should be used to record and link the waypoint name/number with a more detailed description of the location. This log can then be used to identify the waypoints by the three digit waypoint numbers stored by the unit. This is necessary because the unit can only store six characters in the waypoint name field; many times more than six characters are needed to describe the point. *For EP **do not** use the sample custody sheet. Record the waypoint information on the JRMT Sample Inventory Log.*
   f. The information included in the log can later be added to the ASCII text file created when the data is processed. See H.2.t. of this document.

2. Instant reading waypoint collection (This is the preferred method of waypoint collection for EP sample and plume tracking purposes.)
   a. From the **Map Page** or **Position Page**, with the unit held steady at the desired location, hold down ENTER/MARK button until **Mark Waypoint** screen pops up.
   b. If you wish to change the waypoint name/number follow steps **G.2.b.(1)- (4)** below, otherwise skip to **G.2.c**.
      (1) Highlight the name field to the left of **'Done'** using the rocker keypad and press the ENTER button.
      (2) Input a name for the waypoint by using the rocker keypad. Up and down go through the available characters. Left and right changes the position of the cursor. The waypoint name can be up to six characters.
      (3) Press the ENTER button to store the edited waypoint name.
      (4) Use the rocker keypad to highlight **'Done'**.
   c. Press the ENTER button to save your position.
   d. Record any additional data about the waypoint on your log sheet.

3. Average position waypoint collection
   a. Follow steps **G.2.a.** through **G.2.c.** of the above procedure.
   b. With the unit in the same position that the waypoint was taken, press the MENU button, highlight **Average Position** and press the ENTER button.
   c. Highlight **Save** and press the ENTER button when the **Estimated Accuracy** field and/or **Measurement Count** field reaches the desired value. **DO NOT** move the unit while averaging the position.
   d. Highlight **'Done'** and press the ENTER button to save your position.
   e. It takes about 1 minute to collect 60 measurement counts.

4. Determining Bearing and Distance between two waypoints.
   a. Select the **Main Menu**.
   b. Highlight **Waypoints** and press enter.

c. Highlight one of the two waypoints and press ENTER.
d. Select **Reference** and press enter. Use the rocker to scroll through the current waypoints until you get the one you want as your base or reference location.
e. Press ENTER. You will now have the bearing and distance from your base location to the current waypoint.

5. Accuracy of waypoint collection
   a. Methods to reduce error
      (1) Avoid electrical interference; i.e. avoid taking measurements near electrical substations or high voltage power lines.
      (2) Make sure antenna has a clear view of sky. (Try to stay away from areas with dense vegetation overhead.)
      (3) Check the Estimated Position Error (EPE) and Dilution of Precision (DOP) on the Satellite Status Page. The lowest numbers are the best accuracy and the highest the worst for each. The DOP measures satellite geometry quality on a scale of one to ten. The EPE uses the DOP to calculate a horizontal position error in feet/meters. **A DOP <4.0 shall be required for all waypoints submitted for database/mapping purposes.**
      (4) Check the Satellite Status Page and **make sure the unit has a good lock on at least four satellites.** The unit works best when it is receiving strong signals from many satellites located at different angles from the unit. The left side of the screen shows the position of the satellites in the sky. The satellites are displayed by an assigned number. Highlighted satellites are being used by the unit to determine it's location. The right side of the screen shows the strength of each satellite signal the unit is receiving. The higher the bar the better the signal. A grey bar indicates that the satellite has been found by the unit and the receiver is collecting data from it. A black bar indicates that the unit is using that satellite to calculate it's position.
      (5) If available, a powered antenna can help to reduce error by improving the reception of satellite signals.

H. Data Processing
   1. Uploading waypoint data from Garmin unit to a PC using *MapSource*® software
      a. Connect the Garmin to the PC using the supplied interface cable.
      b. In the menu bar go to **File / Open From GPS...**
      c. Select waypoints and click on **OK**.
      d. By clicking on the waypoint tab on the left of the screen you can see a list of all the waypoints you have collected.
      e. Save the *MapSource*® file (***.mps**) for future reference.
         (1) In the menu bar go to **File / Save as...**
         (2) Type the desired name for the file in the File Name field. The file name should include the date and a short descriptor to denote why the information was gathered and the operators initials (Ex.: 2-25-01 Drill PDB) Further instructions may be given by the GPS administrator about file naming and storage.
         (3) Hit enter to save the file.

2. Exporting waypoint data from *MapSource*® program to an ASCII comma delimited text file.
   a. Open the desired *MapSource*® file.
   b. Select the waypoint tab in the left hand window.
   c. Select all of the waypoints screen that you want exported using a shift or control click (**Ctrl + A** selects all).
   d. Copy (**Ctrl + C**) the waypoints to the clipboard.
   e. Open a spreadsheet program such as Corel Quattro Pro.
   f. Paste (**Ctrl + V**) the waypoints to a worksheet.
   g. This will create a spreadsheet giving you a table of information regarding your waypoints. Included is the waypoint name, time and date of waypoint collection, and the lat/long coordinates of the waypoint.
   h. Select the column with the lat/long coordinates.
   i. Select **Tools / Data Tools / Quick Columns**.
   j. Select the **Block** option for the source.
   k. Select the Destination columns by clicking on the arrow button next to the entry block. This will temporarily close the Quick columns Expert window to allow you to select these columns. Select the currently selected column and the one next to it using a shift click. Then click on the "maximize" button on the Quick columns Expert window.
   l. Click the **options** button.
   m. Select **Delimited** from the **Data Type** pull down.
   n. Select **"Space"** for the delimiting type (selection buttons).
   o. Click **OK**.
   p. Click **Parse.**
   q. Click **Yes** to overwrite the existing data.
   r. The coordinates should now be in two columns one for the latitude and one for the longitude
   s. Delete the columns you do not need (Symbol & Name, Unknown). Make any editorial changes you need to make to Descriptions, ID numbers, etc. Be VERY careful NOT to alter the coordinates. You will NOT need to add column headings. They will be added by the GIS analyst.
   t. Saving this file as an ASCII text file in comma delimited form.
      (1) In the menu bar go to **File / Save as...**
      (2) Type the file name in the File Name field. The file name should include g3 (to indicate that a Garmin GPS III+ was used to collect the data), the first, middle and last initials of the person who collected the data, and the date with underscores between the three. (For example: g3_jjc_4-17-01 would indicate that a Garmin GPS III+ was used by James Joseph Cronin on April 17 to collect the points. If two people have the same initials use the first two initials and a last name to differentiate between the two.)
      (3) Click on the File Type field and scroll down to select **ASCII Text ("Comma delimited")**.
      (4) Hit enter to save the file.

I. Data Output

1. Once features are entered into the database, you can use software such as Crystal, ArcView, and VB Viewer to create a table of features that suit your needs.
2. This table can then be used in ArcView to create a map of your feature

locations.

3. With assistance from the GIS unit, you can get the features included on the KDHE Intranet IMS site, which will place your features on a map.
4. Any questions regarding map or table creation of desired feature locations should be directed to the GIS unit at (785) 296-8078.
5. The *MapSource*® software can also be used to perform a variety of tasks.

J. Troubleshooting

1. If the batteries run low a warning box titled **Battery Power Low** will pop up on the screen. If you see this you should replace the batteries.
2. If the unit is not under sufficient satellite coverage a warning box titled **Poor GPS Coverage** will pop up on the screen. If you see this you need to move to another location to give the antenna a clearer view of the sky.
3. If a message pops up on the screen that you don't understand, refer to *Appendix E* in the Owner's Manual & Reference to get a description of the message.
4. If any unresolvable or unrecognizable problem occurs with the unit while being used for field data collection, the unit is to be turned off and returned to the Bureau's/Program's GPS Administrator for inspection.

Appendix A: Glossary of terms

ASCII comma delimited text file - a file that separates columns of information with commas.

AshTech Reliance - a GPS unit that is more accurate than the Garmin GPS III+.

Average Position Waypoint Collection - allows you to average position samples over time and save the averaged result as a waypoint. Averaging reduces the effects of selective availability on position error and results in a more accurate position reading.

AutoLocate - the unit searches for available satellites to determine its position. This option is useful if you've relocated a long distance (>500 miles) from the last location the GPS III+ was used.

Dilution of Precision (DOP) - A measure of the GPS receiver-satellite geometry. A low DOP value indicates higher accuracy. The DOP indicators are GDOP (geometric DOP), PDOP (position DOP), HDOP (horizontal DOP), VDOP (vertical DOP), and TDOP (Time clock offset).

Estimated Position Error (EPE) - A measurement of horizontal position error in feet or meters based upon a variety of factors including DOP and satellite signal quality.

Feature Data database - a KDHE GIS database designed to store GPS information for various feature locations. It is currently in the testing phase.

Geographical Information System (GIS) - A computer system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data related to positions on the Earth's surface.

Global Positioning System (GPS) - A global navigation system based on 24 satellites orbiting the earth at an altitude of 10,900 miles and providing very precise, worldwide positioning and navigation information 24 hours a day, in any weather. Also called the NAVSTAR system.

Horizontal Positional Accuracy - the accuracy of a location on a 2D surface.

Instant Reading Waypoint Collection - the unit takes it's current position reading and saves it as a waypoint.

Selective Availability (SA) - This is an artificial error introduced into the satellite data by the US DoD to reduce the possible accuracy of a position to 100 meters for commercial users. SA was turned off on 5/01/2000 through a federal executive order to encourage the use of GPS units for non-military purposes. It can be turned on again for national security reasons at any time.

Waypoint - the technical term for a location whose coordinates you store.

Appendix B: Checklist of applicable field equipment and supplies

Garmin GPS III+ unit
Owner's Manual & Reference Guide
Carrying case
Cigarette lighter power adapter
PC Interface Cable
Garmin *MapSource*® software CD
Notebook for logging data

Powered antenna (optional)